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PRESERVING OUR NATURAL RESOURCES.

The conference held in Washington last week, consisting of the governors of the various states and the representatives of numerous influential organizations, has already served one valuable purpose: It has advertised most widely our negligence in these matters, and the imperative need for better methods and less selfishness in the future. It has been frequently pointed out that we can already see the ends of many of our most important materials, such as wood, coal and iron ore, but such statements have always been received with more or less indifference, as the croakings of over-excited pessimists. But at this conference it was the unanimous opinion of those present, who, it may be said, represent, in a way, the best of the country, that we have reached a critical stage, and unless we immediately give more attention to these important matters, before long we will find it too late to repair the damage done. It is, therefore, a most excellent thing that actual figures given by some of those who took part in the discussions indicate the rate at which exhaustion and deterioration are going on. We are systematically exhausting the soil by bad methods of farming. We are systematically depleting the forests, and making but little effort to protect those still left from the ravages of fire. We are thus not only destroying the resources of wood, but ruining the rivers for navigating purposes, and working havoc on the arable land. A ringing warning has now been given, which should be heeded, but the methods by which the conservation of these resources is to be carried out remain to be determined, and it is to be hoped that this conference is only the first of many which will bring about co-operation between the states and the general government.

In one sense, the most important problem is the preservation of the fertility of the soil. This is mainly a question of proper cultivation and fertilization. Next in importance probably come the resources of coal and iron, for when these are once gone, they are irreplaceable. Regarding the iron ores, it may be said that there is little waste. The chief criticism to be made is our use of only the highest grades of ore, and the neglect of the poorer ones, which will, of course, result in increasing the cost of iron and steel to future generations. In the uses of coal, however, we are most wasteful. The best only is taken out, with a loss of something like twenty-five per cent. So far our methods can be criticized only because they will make fuel more expensive in years to come. But it is unfortunate that our methods of using coal after it leaves the mine are also bad. For the blast furnace we coke it, and allow a good part of the heat energy to escape in the gases. As a source of power, we use it in

methods which would be disgracefully bad if we knew of any better. The best we can do is to use it in a gas engine, the thermal efficiency of which is only twenty-five per cent. When we use it for driving steam engines, the thermal efficiency drops to ten per cent or less, generally very much less. For heating our buildings and other similar purposes we still use, in general, apparatus far from good; and were it not for the fact that a transformation from chemical energy to heat energy takes place with an efficiency of 100 per cent, and such devices need be charged only with the actual loss of heat which they allow to escape and with no loss due to the transformation, they would show far less creditable performances.

The question of efficient power production calls up again the old problem of a direct conversion of the chemical energy of coal into electrical energy; but in spite of the fifteen years or so since the importance of this problem was brought out, we seem to be no further toward its solution. We know how we should not proceed. We also know how success might be obtained, but we have never yet been able to devise a means for securing it.

The problem of controlling the rivers, which is bound up with that of preserving the forests, is most vital, since it involves so many other problems. But here the situation is different, since it is not a question of preserving something which is gradually used up, but of properly protecting and developing what we have, which should be inexhaustible. A satisfactory solution of this should go a long way toward solving the question of economical power production and relieving one of the main drains on our coal supply.

The practical results of the conference will be awaited with interest, but since the conference has no power, and can only suggest and recommend, the good which it accomplishes will, in a large degree, depend upon the individual efforts of those who took part in it, and the extent to which they secure the interest of those with whom they have influence.

THE QUALITY OF ARTIFICIAL LIGHT.

At the meeting of the New York section of the Illuminating Engineering Society, which is reported elsewhere in this issue, Dr. E. L. Nichols, of Cornell University, presented a paper of exceptional interest. Heretofore the attention of this society has been directed mainly toward the study of the intensity of illumination and the proper methods of obtaining it. On several occasions, it is true, it has been urged that quantity in illumination is not everything; that the question of quality may frequently be far more important. But such discussions, while perhaps indicating the suitability, or non-suitability, of certain types of lamp, have not given us any satisfactory method of determining the relative values of our different light sources with respect to quality, and it was with the object of doing this that Dr. Nichols prepared his paper.

Before any satisfactory comparison can be made, it is necessary to determine some standard. It is well enough to say that the light from one lamp is redder or less red than that from another, but this in itself neither condemns nor commends either lamp. Not until some standard is adopted is it possible to compare, in an intelligent way, the qualities of the different lights produced. Thus the first problem before Dr. Nichols, and really the most difficult to solve, was: "What may be taken as the standard of comparison?" The answer most usually given to this is, "a white light;" but there remains the difficulty of deciding what is a white light, since white itself is not a color but a mixture of all colors. Occasionally it is urged that a light having a yellowish color is easier for reading, but even if this be true, it does not follow that the yellowish light should be taken as the standard, for, given a known standard, it will be easy enough to specify, if desired, a light having a greater preponderance of yellow. Dr. Nichols decided, for various reasons which are given in his paper, that the most satisfactory standard was the white light of daylight. The most important reason for this is that this seems, on the whole, to be the light most suitable for the human eye.

Having decided that daylight was to be the standard, there yet remained the more difficult part of the problem, that of deciding upon the normal composition of daylight. Daylight varies enormously, not only in intensity, but in quality, from season to season, and from hour to hour during the day. It is affected by the position of the sun, by the condition of the sky and by surrounding objects. In the open country in summer there is more green than is found in the built-up city or upon a snow field. In high altitudes the blue end of the spectrum, particularly the ultra-violet, is the more intense. This difficulty was solved by averaging about 150 measurements of the composition of daylight made in various parts of the world, at various altitudes, and under various conditions. From these three standard curves are deduced: One showing the average for high altitudes, where the blue is more pronounced; another for low altitudes, and the remaining one the average for all the observations. There is considerable difference, as might be expected, between the averages, but it was found by comparison with various artificial lights that the differences existing between the former are so much less than the differences between the curve of an artificial light and any one of the daylight curves that practically the same results were obtained no matter which daylight curve was taken as the standard.

Having thus determined upon a standard of comparison, Dr. Nichols compared with it the lights produced by the more common illuminants, such as gas burners of various types, acetylene, incandescent lamps of all forms, etc. To make the comparison it was necessary, of course, to reduce the intensities of some particular part of the various spectral curves to the same value, and, as is customary, this was done for a particular wave-length in the yellow. Comparison was then made by determining the ratios of the intensities of the various wave-lengths of the spectrum of the artificial light with the intensities of the corresponding wave-lengths in the standard daylight curve. The most noticeable feature of these curves of ratios is then the steep inclination to the axis of wave-lengths. A curve showing close similarity to daylight would be nearly a horizontal line, while every one of the artificial lights gives a curve steeply

inclined to this axis; and it is very noticeable, in spite of the dissimilarity which we usually associate with the different sources of artificial light, that when compared in this way the curves do not lie very far apart. In general they are marked, as is to be expected, by a preponderance of the radiations at the red end of the spectrum and a corresponding deficiency at the blue end. This is typical, of course, only in those illuminants giving a fairly continuous spectrum, and the characteristic is one indicating poor luminous efficiency, because, since the curves are all constructed to intersect at that wave-length which practically determines the candle-power of the light, these curves all correspond to equal candle-powers and the preponderance of radiations at the red end of the spectrum, where the energy is great, means a large waste of energy which is not at all compensated for by the deficiencies of the short wave-lengths, since the energy which these represent is negligible as compared with the other. These curves bring out an important characteristic of the newer types of incandescent lamp. The characteristics of these are less inclined to the axis of wave-lengths, thus indicating a higher luminous efficiency.

The characteristics of those illuminants which show selective radiation, such as the Welsbach mantle, the lime light, and others, also show poor performance as compared with standard daylight, but here the efficiency as light producers is noticeably better than for those illuminants having approximately the characteristics of a "black body." An important feature of illuminants of this class is the fact that, while being more or less selective, they do give a considerable amount of light from all parts of the spectrum, and the quality may be said to be better than for the third class of illuminants, those which do not give a continuous spectrum.

Among the latter class of illuminants are the mercury vapor, vacuum-tube lamps, and magnesium flame, and in this class are put also the various forms of arc lamp, since the latter show, in addition to a continuous spectrum, luminescent bands. And it should be noted that it is these bands alone which are affected by impregnating the carbons. There is some difficulty in making a satisfactory comparison of the light from illuminants of this class with the continuous spectrum of daylight, but some idea may be gained, as is suggested by Dr. Nichols, by comparing the intensity of the various bands of light given by the artificial source with the corresponding bands of daylight. This is done for the mercury arc, which practically gives but three bands: One in the red, which is about two-thirds as intense as ordinary daylight; one in the green, about two and one-half times as intense as the corresponding color in the daylight, and one in the violet, which is about four times as intense.

While Dr. Nichols has not by any means exhausted this field, he has given us enough information to enable us to talk intelligently of the quality of light given by our various artificial sources. He also shows the type of characteristic to be sought when a higher luminous efficiency is desired, but no method of greatly increasing this efficiency, other than by seeking for materials which will be stable at still higher temperatures or substances having marked properties of selective radiation, is indicated. Probably in the latter direction lies the most promise. While it is true the efficiency is very greatly increased by luminescence, what is gained in this way is lost in quality, since luminescent sources usually radiate light from small sections of the spectrum only. For many purposes such light will be entirely satisfactory, but when it is a question of lighting colored objects, such light is apt to be very deficient. It is an important fact that the lack, or marked deficiency of a certain color in a light, while possibly making no appreciable difference in the candle-power of the light, or in general effect, is brought out sharply when this light falls on an object which reflects only that color. Objects show color only by reflecting light which falls upon them, and if the only color which they can reflect is absent, they show no color. Fortunately, however, most color effects are satisfactorily produced by various proportions of the three primary colors, red, green and violet. So that if a luminescent source could be devised which would produce these three primary colors in satisfactory proportions, the problem of luminous efficiency might be solved.

NATIONAL ELECTRIC LIGHT CONVENTION.

The National Electric Light convention is always one of the most important of the electrical meetings of the year. It was held this week in Chicago, a city noted for its electrical enterprise and development. The usual excellent programme of papers, both of technical and business interest, was presented, and an unusually good exhibition of apparatus was shown. The first report of the convention is presented in this issue.

The activities of the National Electric Light Association cover many and different lines of work not at all appreciated by those who are not familiar with the work of the association. Its proceedings deal not only with the technical problems in the production and distribution of electrical energy, but with commercial problems, questions of policy, and other phases of the work which technical bodies do not usually consider. Few laymen, indeed, have the slightest conception of the part which the central station plays in our every-day life. They have grown accustomed to obtaining light, or a cooling breeze, by merely pressing a button, never for a moment stopping to think what it means to have electric power at command at any moment of the night or day.

During the past year or two some new problems have come up before this association, the proper solution of which will mean much to the prosperity of the central stations and in increasing the use of electrical power. One of these questions of vital importance is that involved in the introduction of the new high-efficiency lamps. The immediate introduction of these lamps everywhere, were it possible, would mean an enormous reduction in the output of the central stations, but this is impracticable because of the inability of the lamp companies to turn out the new lamps in sufficient quantity. Their use is coming, however, as rapidly as possible, and the best method by which this is to be brought about, so that all will benefit from the improved lamps, has not yet been clearly pointed out.

National Electric Light Association.

Thirty-first Convention, Auditorium, Chicago, Ill., May 19-22—The Opening of the Exhibition and Reception—The Opening Sessions of the Convention.

(*Special Despatch to the* ELECTRICAL REVIEW.)

CHICAGO, ILL., MAY 19.—The thirty-first convention of the National Electric Light Association opened very auspiciously at the Auditorium on the evening of May 18 with a private view of the exhibits of the Class D members and a reception, followed by dancing. The attendance was very large and notwithstanding the fear that recent difficulties in business would keep many away, there was no falling off, and a note of great cheerfulness and buoyancy was everywhere predominant. The special trains provided excellent service and the several delegations arrived in good time to get ready for the strenuous week that followed.

The exhibit this year is arranged in the ballroom of the Auditorium. Though rather smaller than the space which has been available heretofore, there is a compactness and symmetry that enhances the enjoyment of this feature of the convention. Then, again, there has been a striving after decorative features that has hitherto not been attempted, and the result justified the wisdom of the Exhibit Committee, and the commendation with which this year's presentation was received is indeed well merited. Conspicuous among the exhibits were those of the Allis-Chalmers Company, the General Electric, Westinghouse, Western Electric, Federal Electric, Simplex Heating, American District Steam, Crocker-Wheeler, Fort Wayne, H. W. Johns-Manville, Triumph, Central Electric and Wagner companies. The engineering department of the National Electric Lamp Association made a notable exhibit, demonstrating the availability of the tungsten lamp for superior lighting. In fact, the whole scheme of lighting demonstrated the effectiveness of the new incandescent lamps, which were arched, festooned and clustered in great profusion. Several flaming arcs were shown and the front of the Auditorium was flooded with light from a number of Excello, G.-I., Beck and German-American electric flame arcs.

The first formal session of the thirty-first convention was called to order on Tuesday morning. The excellent scheme of registration had facilitated the distribution of papers, and when the session assembled ample time had been, in most cases, available in which to digest the subject matter.

President Dudley Farrand called the first session to order and proceeded at once to deliver the annual address. He said all should recognize the power for good of the association. The membership had grown and was now 1,327, with 664 Class A members. He hoped that the present form of the Question Box, in bulletin form, which had proved very satisfactory, would be continued. The interests of the member companies' customers had suffered in the recent business depression, but there were distinct evidences of improvement, and he predicted an early return to prosperity. The agitation against corporations, resulting in appointment of commissions, was discussed, and Mr. Farrand emphasized the necessity where there was danger of unjust legislation to protest very vigorously. The idea of effecting a maximum rate for a given locality is contrary to the laws which govern the operation of the service, and imposes unfair burdens on different users of current. The associations should cultivate a closer affiliation with the state organizations, but should not encourage the formation of sub-organizations to discuss specialized subjects. This could be properly handled in parallel sessions under the direction of special committees. Mr. Farrand recommended the appointment of a representative to take part in future conferences called by the Government to discuss the conservation of our natural resources.

Several announcements were made by the secretary and the report of the Committee on Progress was presented by T. C. Martin, chairman.

Owing to the high cost of material and supplies, notably copper, there had been for some months previous to the financial panic of October last a slowing down in the pace of expansion, so that, as a whole, the industry was able to meet the conditions with reasonable equanimity and fortitude. The total American plants up to April, 1908, would appear to be 5,037, or, including 396 Canadian and sixty-two Mexican, a total of 5,495 for the North American continent. No question during the past year has occupied greater attention on the part of electric light and power companies than those which concern relations with the municipality or the state. There have been decisions of importance by public service commissions and by the courts affecting rates. Legislation has overshot its mark, and it has come to be perceived that public service commissions can not be constitutional in character unless they protect the interests and properties of the corporations as equitably as they do the rights of the public to decent, honest treatment. It can not be said that, in general, anything particularly new has developed in central station design and construction during 1907. The year has seen a continued and increasing use of the steam turbine generator units, especially in the larger plants. The year has witnessed in some instances a lessened use of sign lighting, but not so much as might have reasonably been expected. The higher-efficiency incandescent lamps have taken hold with great impetus, and the introduction of these to the consuming public has now become a vital factor in central station practice. The new flaming arc lamps are being installed in large numbers, and are competing very effectively with the newer forms of incandescent lamps. Various improvements have been made during the year in vacuum tube lighting, this improvement referring more specifically to mercury vapor lamps of the Cooper Hewitt type. Notwithstanding the depression which took place in other directions, the sale of electric heating apparatus continued and this branch of the art made considerable progress. The year has witnessed a steady growth in motor applications and utilization, and new fields have been added without any particular requirements as to modifying the motor itself.

The paper entitled "Distribution in Suburban Districts" was read by the author, George H. Lukes.

The distribution of electricity for commercial lighting and power in suburban districts is now almost entirely by alternating current at sixty cycles. The three-phase, three-wire system is ordinarily used for transmission, the voltage ranging from 6,600 to 22,000. In deciding upon the transmission voltage to be used there are a number of points to be borne in mind. If possible, the ultimate voltage

at which the system is to operate should be settled upon at the start. If this is done, equipment can be purchased that will not have to be discarded when a change is made to a higher voltage. If possible, the voltage should be the same as that used by other companies operating in adjacent towns or districts. This facilitates the interchange of current between companies and the quick transfer of apparatus in emergencies. If it seems inadvisable to adopt the voltage in use by neighboring companies, a little money spent for extra taps in transformers, so that they will be interchangeable with those of other companies, is often good policy. On transmission lines the practice of placing the insulators so that the wires will be at the points of a triangle is common. Provision is frequently made for two transmission circuits on the same pole, one on each side of the pole. The separation between the wires of the transmission lines should be made sufficient at the start for the ultimate voltage. If it is necessary to carry the local distributing wires on the same poles with the transmission wires, the separation between the different sets of wires must be ample to allow linemen to work on the local wires while all wires are alive. Five feet is usually enough for the purpose, and this is sometimes made less at crossings where high poles are required. Insulators should be selected with the idea of having a good factor of safety when the system is operated at the ultimate voltage. The importance of having a good insulator can not be overestimated, and an additional expenditure on insulators alone of $25 per mile of line may result in more reliable service. Standard practice seems to have settled down to the use of some form of iron pin, reliance for insulation being placed entirely on the insulator. Transformer substations may range from a structure of wood or corrugated iron mounted on two poles to a fireproof building equipped with a switchboard and with all the modern high-tension controlling and regulating apparatus. A decision as to proper location and type requires careful consideration, and in building it is always wise to provide for the future. As a general rule, the substation should be located as near as possible to the centre of load of the district it is to supply. The substation must be where both high and low-tension overhead lines can be brought to it with the least objection from property owners and public authorities. The duration of the franchise and the present and prospective relations with the public authorities in the village or city must also be considered. The greater factor of safety secured by the use of three transformers instead of one in the relatively small suburban substations seems to warrant their use even at some extra cost. Automatic high-tension oil switches, with all the appurtenances, run into money very fast, and a good deal of judgment must be exercised in their selection. If the transmission line is controlled by automatic oil switches it is desirable to equip similarly the primary feeders or circuits. A combination of fuses on the feeders, with an automatic switch on the transmission line, works badly in case of a short-circuit on a feeder, on account of the time element in the fuse. The demand in suburban districts being principally for current for lighting and small power, a large part of the distribution is by means of single-phase feeders. The three-phase system is supplanting the two-phase system on account of its greater economy and adaptability to all conditions. The four-wire, three-phase system seems to have many advantages over other systems for suburban work. In this system the generator or transformers are Y-connected, the neutral being brought out and connected to a ground fourth bus-bar. Secondary distribution for lighting is almost universally from three-wire secondary mains or buses at approximately 110-220 volts, customers being supplied at 110 volts for installations up to twenty or thirty lights, and at 110-220 volts for larger installations. Generally, in the suburbs a lighter type of overhead construction is permissible. Wires carrying the highest voltage should be on the upper cross-arms. Feeders and circuits to remote points should also be on the upper cross-arms, where they will not be disturbed. Primaries and street-lighting circuits for local use should be on the lower arms, where taps to transformer connections can be conveniently made. Secondary wires should be on the lowest arm by themselves. In a well-designed distribution system feeders of sufficient capacity run from the station or substation to centres of distribution. No primary main or transformer should be tapped off between the station and the centres of distribution. The pressure at the feeder end is kept constant by means of feeder regulators of either the induction or the switch type. The analysis of distribution losses is a matter that is apt to be neglected in most cases, but systematic attention to it is necessary for efficient operation. Where a company is forced to put considerable of its construction underground, it is poor policy to put any but the best material into this construction. In an overhead distribution system it is often a fact that slipshod records are kept. Accurate pole-line records are a convenience to all departments of the company, and a positive necessity to the operating department if good results are to be obtained. The essential features for commercial distribution are, first, a record of each transformer showing, in addition to the data on the transformer itself, its location, feeder from which it is supplied, and its connected load; second, a record of each feeder, showing route followed from station to centre of distribution, with its system of primary and secondary mains. When a company is not large enough to afford a department of records, it is wise to make this work a part of the routine of several employés, both to secure a check on the work and to insure its being carried on through the inevitable changes in the personnel of the orzanization.

The discussion on this paper was opened by Farley Osgood, who agreed with Mr. Lukes that a line should be built to carry its alternate voltage and current. However, this was not sufficiently emphasized. Either construction as good as possible should be used or the company should stay out of the locality. He did not approve of a galvanized iron pipe for a ground and considered that where it was not possible to ground to water mains or similar services nothing but a well-installed copper plate ground should be approved.

Peter Junkersfeld thought that there was not enough attention given to the matter of pole-line records. He believed that if the overloading of pole lines were watched closer it would postpone the placing under ground of distributing systems in suburban districts.

H. B. Gear stated that the galvanized iron-pipe ground had been used with success in Chicago, and that the four-wire, three-phase system was also a great advantage in handling unbalanced loads.

Dr. Charles P. Steinmetz emphasized the necessity of protecting transmission lines from lightning, and cautioned operating men against the use of two single-phase transformers in open-delta. This was unsafe and unreliable.

The question was raised as to what constituted the high-tension system limit, and the consensus of opinion indicated that the limit of 5,000 volts, as has been adopted by the Underwriters, be consid-

ered standard. A motion was carried to have a committee appointed to draft suitable resolutions covering this matter.

The paper by Paul Lüpke, entitled "Tape," was read by I. C. Marfin and received with great enthusiasm.

This paper gives a brief analysis of the functions of red tape in the executive department of a corporation. Mr. Lüpke thinks that there must be red tape in order to prevent chaos, but those charged with its handling face a grave responsibility. The secret of the use of red tape is in not allowing it to become a burden. Intelligent approximation is a high art. Nothing will promote economy more effectually than a continuous, uniform rate of production. In handling red tape there are really but two points to be observed. These are strict compliance with the rules and the avoidance of errors. The thorough-going manager should relegate relentlessly to some one else the things that some one can do as well as himself. Thoroughness does not mean indiscriminate attention to an agglomeration of petty details; it means the intelligent elimination of unessentials and a firm grasp on matters of vital importance. It should be one's constant aim so to manage his affairs that they will run smoothly and efficiently without him; for the moment a person has reached that point, that point invariably coincides with the moment for his promotion. Retrogression begins the moment one is convinced that he is doing his best. There really is no best. The man needed and wanted is he who can stoutly and with ability defend his own opinion while a matter is under discussion and open to argument, and who, if overruled, is broad enough to bring his best efforts, with true loyalty, to bear upon making an unqualified success of the opinion that prevailed. In short, the coming man must be able to abide by the decision of the court and go to work.

The report of the Committee on Grounding of Secondaries was read by W. H. Blood, Jr.

The committee has drafted a rule, working in conjunction with committees from the American Institute of Electrical Engineers, the Association of Edison Illuminating Companies and the National Electrical Inspectors' Association, which was submitted to the Underwriters' National Electric Association at its meeting in New York in March of the present year. This is designated as rule 13 A, and will eventually form part of the National Electrical Code. It is the opinion of all that when this rule has finally been put into the code it should be made mandatory and not permissive. Except for minor details, the only serious point at issue seems to be whether the limiting voltage shall be 150 or 250. The committee is unanimous in its opinion that alternating-current circuits carrying less than 150 volts should in all cases be grounded. Above 150 volts the grounding should be made prohibitory. The committee suggested the following resolution:

"*Resolved,* That it is the sense of this meeting that it is desirable to have inserted in the National Electrical Code a rule making mandatory the grounding of alternating-current secondary circuits up to and including 150 volts, and a provision making prohibitory the grounding of secondary alternating-current circuits carrying in excess of 150 volts."

The Tuesday morning session closed with the reading of the paper, "Series Incandescent Systems with Tungsten Lamps," by P. D. Wagoner.

The recent development of the Gem high-efficiency unit at 2.7 watts per candle, and the tungsten lamp at 1.25 watts per candle, places the series incandescent system on a basis to compete effectively with other systems of street illumination. Indications of most satisfactory tungsten life have been secured in actual practice. For example, in one installation of 172 lamps an average life per lamp of 1,350 hours has been obtained. A test conducted on eighteen lamps of this type resulted in twelve lamps burning over 2,000 hours without breakage or perceptible decrease in efficiency. It is therefore reasonable to expect an average life of 1,500 hours at 1.24 watts per candle. Considered as a mere source of light, the series arc lamp is of higher efficiency than the tungsten lamp, but this fact does not necessarily mean higher illumination efficiency. As illumination varies inversely as the square of the distance from the source of light, and since, therefore, the intensity of light falls off very rapidly as the distance from the source increases, there are many cases in which a more uniform, and therefore more satisfactory, illumination can be obtained by means of incandescent lamps placed at closer intervals than by arcs of greater total light flux placed at longer intervals. The incandescent lamp is best adapted to streets requiring a lower intensity, where arc lamps, to compete economically, would have to be placed so far apart that the intervening space would be practically unlighted, though an unnecessary intensity would be provided in the immediate vicinity of the lamp.

The Tuesday afternoon session was opened by the reading of the report of the Committee on Organization Possibilities, by Henry L. Doherty. The following committee was appointed to draw up resolutions upon his recommendations: W. W. Freeman, F. M. Tait, L. A. Ferguson, W. H. Blood, Jr., and Arthur Williams.

The discussion on the report of the Committee on Grounding Secondaries was again taken up and a resolution adopted recommending as the sense of the association that a rule be inserted in the National Electrical Code making mandatory the grounding of secondaries on all systems of 150 volts and under, and making prohibitory the grounding of secondaries of systems of over 150 volts.

The paper on "Power Developments in Small Stations," by Charles Robbins and J. R. Bibbins, was read.

This paper analyzes the development of power loads on small stations and seeks to establish standards whereby the manager can have indicated to him the factors which govern the best selection of customers, so as to make it possible to operate the station at maximum efficiency. Curves from a successful operating station are analyzed, and a hypothetical case assumed, showing wherein improvement can be made by selecting the proper forms of prime movers and establishing correct relations as regards the long-hour and short-hour consumers. The long-hour user at a low rate is more profitable than the short-hour, high-rate consumer. This involves the question of the proper apportionment of fixed charges between long and short-period service, so as to render these charges commensurate to the service rendered. It is obviously improper to load the long-hour customer with the same amount of fixed charges as a short-hour consumer. There can be no doubt that in every industrial community there exist users of power who can, with advantage to themselves, use central-station service instead of generating it by the various methods at present in use. An important step, and perhaps one of the most necessary, is to see that each power prospect is fully advised that the central station is ready to serve his requirements. This may be done by general advertising and personal solicitation, with the reasonable expectation that a high average of results will lead to a satisfactory load curve. Another method, and one that is used by manufacturers of other commodities, is

to classify all the possible purchasers into related groups and then to plan a separate sales campaign adapted to each of the classified lists of prospects. The problem that confronts the electrical manufacturers of to-day, to a great extent, is the proper selection of the right characteristics required of a motor and the method of controlling its operation, together with the proper combination and operation of the electrical unit with the machines it is intended to drive. The practice of to-day is not simply to belt a motor to the line shaft or gear the motor to the machine, but it is to give the most minute consideration to the selection of the controller and its location, to the characteristics of the motor and the methods of applying it, and to the effect the combination will have on the cost of the product. Curve-drawing meters in temporary or permanent connection with motor installations will show some surprising results and at once suggest and cause the immediate modification of many methods of accomplishing work heretofore considered very satisfactory.

This was discussed by Messrs. Dahm, Almert, Wilcox and Spencer.

The paper entitled "The Small Station and Its Economical Operation," by J. T. Whittlesey and Paul Spencer, was then presented.

The authors consider that it should be the cardinal principle in all station design that no piece of apparatus or any appliance should be installed that can not justify itself not only on the basis of the economy promised by the manufacturer, but also on the most conservative basis. The simple design is always the safer one for the manager of a small station to adopt. Simplicity of design does not mean lack of design, and it is probably of even more importance in the cost of a small plant than of a large plant that it should be arranged at the start so that it can be developed along definite lines. Everything points to the fact that all companies, sooner or later, will be operating under restrictions imposed by state commissions. The value of displaced apparatus can no longer be charged to capital account. It becomes of the utmost importance that each station should be able to grow along definite lines, utilizing to the end of its useful life all the apparatus it may have. In choosing a site one should be selected that will have railroad facilities, and if possible a supply for condensing water, as a condensing plant will be desirable when the load has grown to a certain point. The stack should be of brick, as steel stacks will in every case be found to be the more expensive in the end, both because they require a constant maintenance charge for painting, and because, sooner or later, they must be replaced. For a small load, say under 1,000 horse-power, the authors believe that a simple non-condensing station will show the best possible economy. The generating unit should be direct-connected with engines, preferably of the Corliss type, of moderate speed. The boilers may be either fire-tube or water-tube, but should be hand-fired with no elaborate machinery for handling fuel or ashes. The station auxiliaries should be reduced to a minimum. The switchboard design should provide for exciter panels located in the middle of the board, with sufficient space left for all future extensions. The connections from the generators to the switchboard should be carried in cable under the floor and the outgoing feeders should also be carried under the floor to a wire tower at the corner of the building. The chief engineer should see that the capacity in apparatus running follows closely the load curve. He should have an indicator and take frequent cards so that he may know at all times the condition of his valves and cylinders, and remedy any defects that may be shown. The cutting-in and out of boilers and banking of fires must be watched as closely as the running of the engine room, to make the boiler capacity meet the loads most economically. The combined boiler efficiency, including the grate and heating surface, can be kept up to the highest point only by constant attention to the condition of the boiler setting and the tubes. One great source of loss in boiler efficiency is the bad condition of boiler setting, cracks around drums and other points in the setting which admit cold air, decreasing the draft and lowering the temperature. It is essential for the economical operation of a small plant that integrating wattmeters be installed on each generator, and the daily output kept on a log sheet. The engineer should have his pay-rolls and bills for material so that with a very small amount of bookkeeping he can get the actual cost of labor, fuel, oil and waste, repairs and buildings, engines, boilers and electrical apparatus.

The paper by Alexander J. Campbell, entitled "The Future of the Question Box," was read, and the recommendations contained therein referred to the coming administration with power to act.

This paper reviews the history of the Question Box, which was conceived just before the Cincinnati convention, in 1902, by Henry L. Doherty, then president of the association. Mr. Doherty's idea met with instant success, but the question now arises as to what extent it should be continued. In presenting the Question Box at Atlantic City in 1906, Paul Lüpke, the editor, reviewed some of the disadvantages of the method then followed and suggested that the association print a handbook which should, in a way, take the place of the Question Box and be an authoritative reference book. The matter was not taken up by the association at that time, and again the following year Mr. Lüpke recommended that changes should be made in the method of carrying on the work. The faults were that the volume was published annually, and often the answers reached those asking the questions too late to be of value. Furthermore, there was a large repetition of questions covered in previous issues, and some useless and unnecessary matter. The inauguration of the monthly bulletin and the publication of the Question Box in connection with it eliminated one of these faults. Two distinct functions are performed by the Question Box: In the first place, it is a means of obtaining answers to specific questions. It is also a means of exciting and maintaining interest in the association work among members who would not otherwise take part. Mr. Campbell suggests that the association should publish a handbook. This should reduce the number of questions asked. He also urges that the Question Box be continued as a part of the monthly bulletin, as at present, to take care of questions to which an answer might not be found in the handbook, and to keep the interest alive. He suggests that either a single editor or a committee be appointed to publish for next year a handbook that shall consist largely of compilations from the previous issues of the Question Box, supplemented by such new material as the editors shall be able to gather during that time. Immediately upon the publication of the handbook a revision committee should be appointed and given three years in which to produce a more complete handbook.

The report of the Committee on Uniform Accounting was read, and a resolution carried adopting the classification of income and expenses recommended.

The session closed with the appointment of a committee to prepare resolutions specifying the limiting potentials of high-tension circuits so as to bring this designation in accordance with the Underwriters' National Electric Association. This committee is composed of Paul Spencer, G. H. Lukes, C. P. Steinmetz, E. H. Davis and I. E. Moultrop.

A. A. G.

Electric Power in Iron and Steel Mills.

In the discussion of a paper on "Electric Power in Iron and Steel Mills," read recently before the Engineers' Society of Western Pennsylvania, Professor W. Trinks took the stand that in some cases there was no gain to be secured by the introduction of the motor drive in rolling mills. He said that a well-designed rope drive may have an efficiency of ninety-five per cent, which is considerably better than the eighty-five per cent of the motor drive. The efficiency being better for belts and ropes than for electric transmission for short distances, it follows that the latter form of drive should not be installed without a careful examination of the other two. About two years ago German engineers were enthusiastic on the subject of large electrically driven hoists for deep mines, but the advantages gained were due to the fact that the motors replaced old and inefficient steam hoists; and when the engine builders realized the inroads that the electric motor was making in this field they redesigned their machines to effect a saving in steam. By introducing compound condensing engines with suitable regulating devices to prevent the wasting of steam, they have been able to show a better economy than the electric hoists. These hoists are all in large units of about 4,000 horse-power. It is a question whether a similar result will follow in the rolling mill. Here the motor is being installed to replace old worn-out engines, and, of course, gives a noticeable gain. Moreover, the rolling-mill engine has been sadly neglected, particularly the reversing type. All that has been asked of it is that it should run and never break down. Economy has not been considered. For reversing rolls, the steam engine is considerably better than the electric drive because of the rapidity with which it may be reversed. For three high and continuous mills the motor has strong features, making it preferable to the steam engine, but the author believes that the future will see an increasing use of the gas engine coupled directly to large rolls. It should be possible to connect a single gas engine to a series of continuous mills by a rope drive. In introducing the electric motor care has been taken to protect it from the dirt and fumes of the mill, and the same precautions should be taken when using the gas engine, and it ought to be possible to design a gas engine which would be economical at half load as well as full load.—*Proceedings of the Engineers' Society of Western Pennsylvania (Pittsburg), April.*

Gas and Electricity in Massachusetts.

The twenty-third annual report of the Board of Gas and Electric Light Commissioners of the commonwealth of Massachusetts has been issued. In this attention is called to the progress in hydro-electric power development. Although no company for this purpose has yet been organized in the state, one has been chartered in Connecticut, which will probably dispose of a large part of this power in Massachusetts.

The reports of meter testing show about the usual conditions, but few meters being in error more than a few per cent, and these being pretty evenly divided between fast and slow instruments.

The record of accidents caused by gas and electricity during the year is given according to law. This shows that there were 148 fatalities due to gas, about sixty-four of these being suicide. There were about 143 accidents which did not result fatally. The accidents due to electrical shocks are much smaller, as is always the case, there being but fifteen fatal shocks and but thirteen non-fatal cases. About half of these accidents happened to employés of the electrical companies, being due to thoughtlessness on their part.

The part of the report devoted to gas service shows that the average price for gas was $0.923 per thousand feet. There are something over 200,000 gas stoves in use in the state, an indication of the importance of this device. Reports of the operations of the different electrical companies in this state, both private and municipal, are given in some detail. The following tabulation shows the earnings for private companies during the past three years:

Gross	$9,776,430	$8,927,918	$8,108,265
Expenses	5,714,425	5,186,592	4,777,248
Net	$4,062,005	$3,741,326	$3,331,017
Deducting gas profit	789,618	666,710	634,690
Balance	$3,272,387	$3,074,616	$2,696,327
Add other income	186,703	249,292	223,012
Total income	$3,459,090	$3,323,907	$2,919,339
Charges	1,373,567	1,395,274	1,523,298
Balance	$2,085,523	$1,928,633	$1,396,041
Dividends	1,826,802	1,647,088	1,489,247
Surplus	$258,721	$281,545	[1]$93,206

The operations of the municipal electric companies for the past two years are shown to be as follows:

	1907.	1906.
Gross earnings	$449,469	$374,031
Expenses	423,642	390,276
Leaving an apparent profit of	25,827	.....
Leaving an apparent loss of	.....	16,245

The report gives in addition a summary of the legislation affecting the gas and electrical industries during the year.

[1]Deficit.

American Institute of Electrical Engineers.

The annual business meeting of the American Institute of Electrical Engineers was held in the auditorium of the Engineering Societies Building, Tuesday evening, May 19. The report of the board of directors was read by Secretary Ralph W. Pope, which showed that the Institute steadily moved forward during the year, having had an increase in membership of 1,153 and a substantial improvement financially.

The report of the board of tellers showed that the following officers were elected for the coming year: President, Louis A. Ferguson; vice-presidents, C. C. Chesney, Calvert Townley, B. Gherardi; managers, D. B. Rushmore, H. E. Clifford, C. W. Stone, W. G. Carlton; treasurer, George A. Hamilton; secretary, Ralph W. Pope.

The two papers of the evening were then read. These were: "Comparative Tests of Lightning Protection Devices on the Taylor's Falls Transmission System," by J. F. Vaughan, and "Studies in Lightning Performance, Season of 1907," by N. J. Neall. An abstract of Mr. Vaughan's paper appears elsewhere in this issue. A report of the discussion will be published in the next issue of the ELECTRICAL REVIEW.

Toronto Section of the American Institute of Electrical Engineers Elects Officers.

The annual meeting of the Toronto section of the American Institute of Electrical Engineers was held at the St. Charles Café, Toronto, Ontario, on May 15. After the report of the secretary had been read and adopted, the following officers for the coming year were elected: Chairman, W. A. Bucke; vice-chairman, H. W. Price; secretary, W. G. Chace; executive committee, E. Richards, W. H. Eisenbeis, R. J. Clark. After the business session had adjourned the members visited the Main and College exchanges of the Bell Telephone Company.

Illuminating Engineering Society.

The May meeting of the New England section of the Illuminating Engineering Society will be held in the auditorium of the Edison Building, 39 Boylston street, Boston, at 7.30 Wednesday evening, May 27. At this meeting solutions to the problem of lighting a drygoods store will be presented and discussed by representatives of the gas and electric lighting companies.

An Interesting Development of a Small Swiss Hydroelectrie Plant at Chur.

By Frank Koester

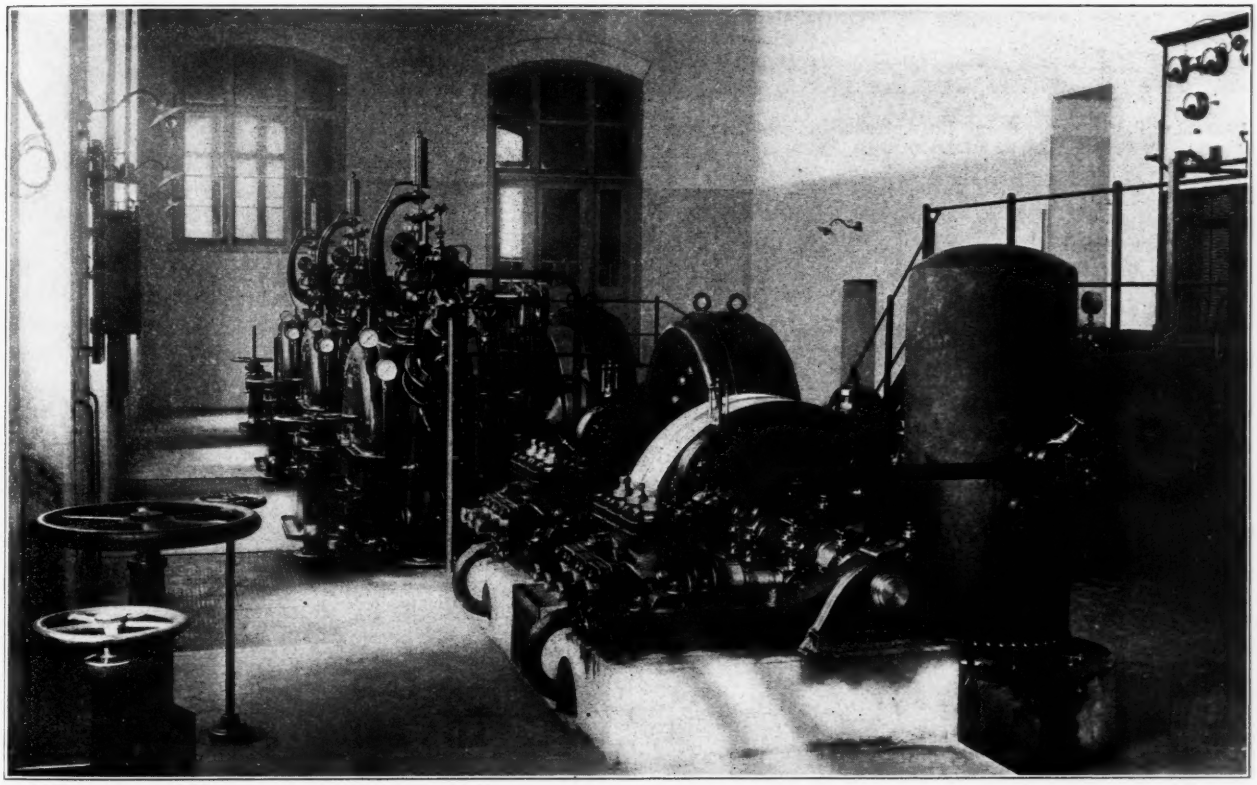
THIS plant, which is located 1.5 miles from the city of Chur, Switzerland, in the Schanfigg Valley, at the junction of the Rabiusa and Plessur rivers, was originally installed for the purpose of supplying 1,300 lamps with a total of 15,700 candle-power. For this purpose the flow of the Rabiusa River was utilized under a head of 185 feet. A dam twenty-nine feet high was built across the stream, providing a storage capacity of 335,000 cubic feet which insured, during times of minimum flow, a capacity of 350 horse-power for ordinary daily runs.

There were installed three 100-horse-power and one 175-horse-power, 2,000-volt, sixty-five cycle, single-phase generators, belt-driven by two turbines.

Additional capacity was soon found necessary, which was provided by the installation of a steam plant, and plans were made for a new project, having in mind the more economical utilization of the flow of the Rabiusa and the flow of the Plessur as well. For this purpose one single new plant has recently been erected, the steam plant being used as a reserve. To provide for a uniform and large water supply, at the head of the above-mentioned storage reservoir, being about 350 feet up-stream, sluice-gates, screens and sand traps were installed on one side of the Rabiusa while on the opposite side an overflow tunnel conducts the surplus water, by-passing the storage reservoir, to a point below the dam. This tunnel is laid through the mountain, mostly through gneiss formation. It has an arched top, is 11.5 feet wide, 11.5 feet high, and 425 feet long, 138 feet of which had to be lined with concrete. The old sluice-gates in the dam, which previously controlled the flow to the old power plant, now serve for draining and cleaning the reservoir. Just above the dam is the basin to which the new penstock is connected, covered by a small building containing sluice-gate, screens and electric signaling apparatus for indicating the level of the water. The penstock, which is 31.5 inches in diameter and made up of rolled steel sections, twenty-three feet in length, is laid in a tunnel which joins the old head-race and continues along the same line to a point at which it crosses the Plessur River over a lattice girder bridge. Here it enters another tunnel 767 feet long, then continues alongside of the state road and finally proceeds underground to the power-house. The penstock at the power-house is made up of three-eighths-inch material while at its upper end it is one-quarter-inch.

The connection between the Plessur River and the power-house is not yet made. It will consist of a tunnel 4,750 feet long, with a pitch of 1.5 feet to the thousand, leading to a collecting basin. From here a penstock, forty-seven inches in diameter, will be carried through a tunnel 900 feet long and will then cross the bridge mentioned where it will enter the tunnel above described and run parallel with the other penstock to the power-house.

The net head utilized of the flow of the Rabiusa is 272.5 feet, and that of the Plessur will be 191 feet. As the water of the former is drawn from the described



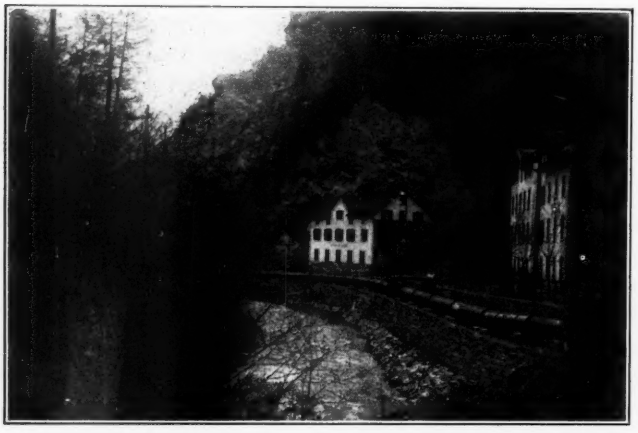
INTERIOR OF PLANT (PRESSURE PUMPS IN FOREGROUND) HYDROELECTRIC STATION, CHUR, SWITZERLAND.

reservoir, the supply of which is limited, and is sufficient only for running the plant from 5 to 8 A. M., and from 5 to 10 P. M., for lighting purposes, and the water of the Plessur gives a steady supply for twenty-four hours, the combined supply will give a total of 1,355 horse-power without the steam reserve. During the longest run, from 5 to 10 P. M., 600 horse-power per hour is derived from the Rabiusa, while from the Plessur, which will give a constant flow, there being no reservoir, 755 horse-power will be derived. The flow of the Rabiusa is at present only utilized for lighting purposes, and in the interim between 8 A. M. and 5 P. M. the flow of this stream is stored in the reservoir. However, when, in the near future, the power of the Plessur shall have been fully developed, both powers may be utilized to supply current for both lighting and power purposes.

The power plant has been designed to accommodate six turbo-generator units, there being three installed at present, each of 250 horse-power. These turbines are of the high-pressure type, as designed by Escher, Wyss & Company, for a head of 272.5 feet and 375 revolutions per minute. The turbines have two needle nozzles supplied from the penstock by a twelve-inch branch and giving a jet three inches in diameter. The turbines are well provided with automatic regulating devices in connection with servo-motors and may also be controlled by hand. The oil supply for the servo-motors is supplied by two high-pressure oil-pumps having a common air chamber. Although the turbines are impulse wheels (similar to the Pelton wheel), they are fitted with a draft tube in order to utilize the total head, as the turbines could not be placed close to the tail-water level.

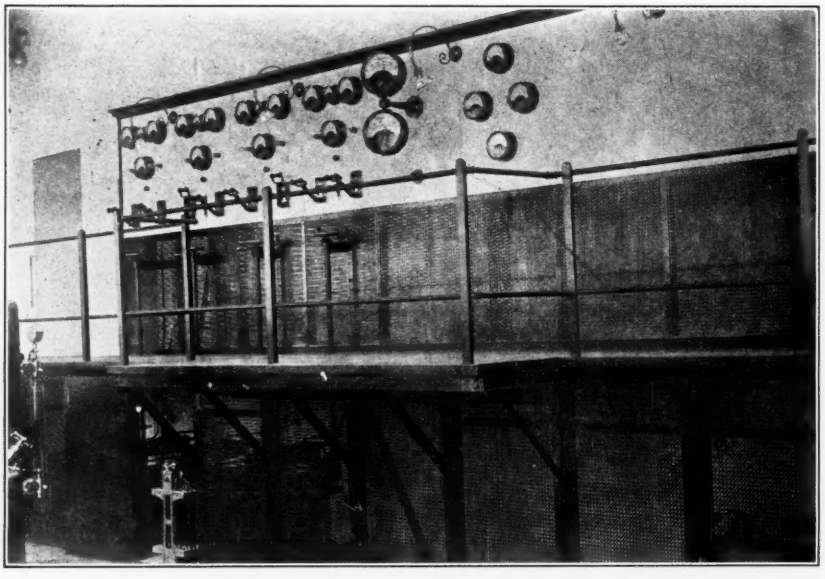
The generators are direct-connected to the turbines by means of flexible insulated couplings. They are 210-kilowatt, fifty-cycle, 2,000-volt machines of the "Oerlikon" make. The exciters are mounted on the generator shaft, an outboard bearing being used, and are thirty-three-volt, 120 amperes. The synchronizing is controlled from the switchboard.

The two-story switch room is located alongside the generator room, the switch gear, in accordance with modern Swiss practice, being situated in reinforced concrete cells. There are two bus-bar systems, one single-phase for light, and one three-phase for power purposes. The switches are so placed that the power from either stream may be utilized so that the current generated may be thrown on either bus-bar system. The switchboard is placed several feet above the generator-room floor and in front of this there is a gallery which is on the same level as the switch

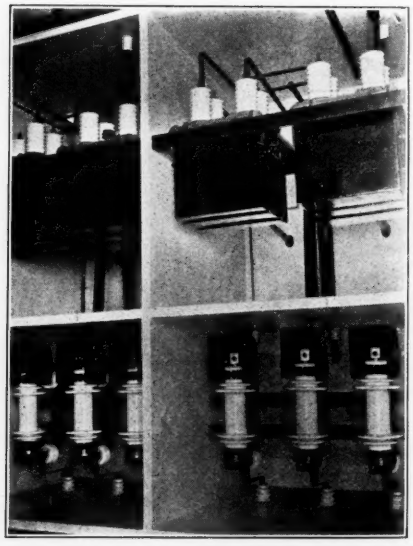


PENSTOCK, PARALLELING STATE ROAD, HYDROELECTRIC STATION, CHUR, SWITZERLAND.

PENSTOCK BRIDGE, HYDROELECTRIC STATION, CHUR, SWITZERLAND.

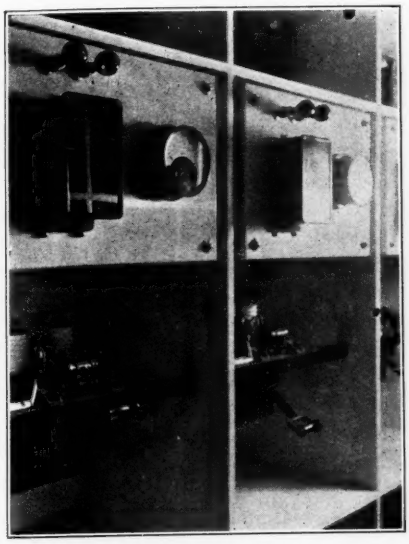


SWITCHBOARD IN THE HYDROELECTRIC STATION OF CHUR, SWITZERLAND.

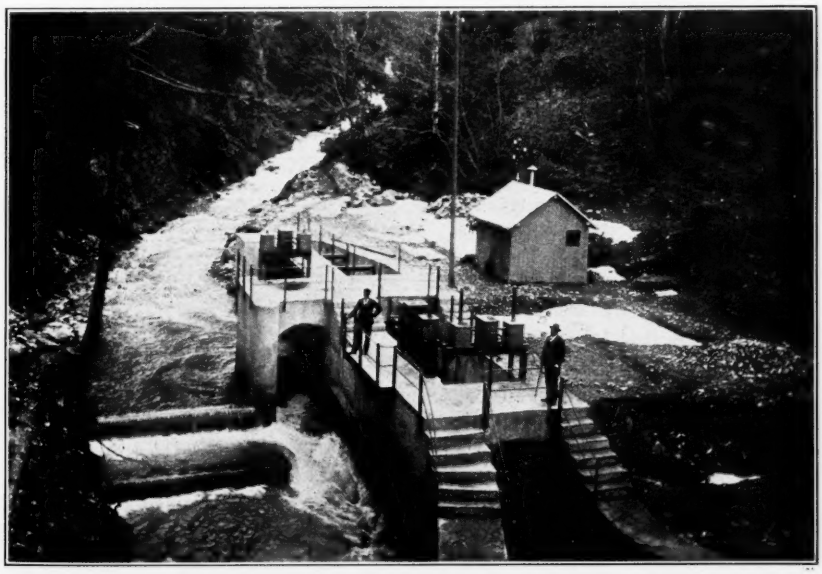


HIGH-TENSION OIL-SWITCHES AND FUSES.

room. The board, which forms part of the partition wall between the generator room and the switch room, is built of structural steel, with white marble panels, upon which the various instruments are mounted. The lower section of the structure is covered with perforated iron, insuring proper ventilation for the switch room. Low-tension apparatus only is mounted on the front of the marble panels, while the high-tension apparatus, such as oil switches, fuses, measuring transformers, etc., is placed in individual concrete cells, none of which is covered. The various apparatus is so placed as to leave a passage way between the rows of cells to permit of easy access to the appliances. With the exception of a single line the outgoing feeders are laid underground. For the supply of current for the power-house itself and for the immediate neighborhood, two ten-kilowatt transformers, one being three-phase and the other single-phase, are located in the switch room. The electrical equipment was installed by the Oerlikon Company, Switzerland.



APPARATUS FOR OUTGOING FEEDERS.



HEAD-RACE, HYDROELECTRIC STATION, CHUR, SWITZERLAND.

Electrically Driven Reversing Rolling Mills.

A discussion is given here by Henry Crowe, of the use of the Ilgner system of compensating for violent changes in the load of an electrically driven rolling mill. This system consists in brief of driving the rolls by a motor which draws its power from a motor-generator group, itself driven by the power supply, and upon the shaft of which is mounted a heavy flywheel. The motor of this transforming group has such characteristics as to allow the flywheel to absorb and give up energy, due to changes in speed, as the load on the rolls is thrown off or on. Moreover, when the rolls are reversed, the system acts as an absorbing brake, thus saving much of the energy which would otherwise be wasted. In large rolling mills the power required may vary from nothing to fifteen thousand horse-power in either direction, but these great powers are not required for long periods, and an attempt to drive such a mill without some such equalizing system would be practically impossible. The Ilgner system has been applied very successfully for this work, but special precautions must be taken to obtain sparkless operation of the generator and the mill motor, since the brushes must be fixed in position. An important advantage of this system is held to be the even torque of the electric drive, as with this there is less likelihood of breakage of boxes, spindles and wobbling of rolls. Another advantage is the fact that when the piece bites the rolls the mill does not appreciably slow down, as the mill motor instantly draws extra current from the motor-generator, enabling it to exert automatically the requisite torque to pull the piece through the rolls. Therefore, the mill will not stall, but will pull anything through up to the maximum power for which the circuit-breakers are adjusted. For the same reason the mill will not appreciably race when the piece is through the rolls, although the driver will naturally use the inertia of the mill to perform the rolling of the tail end of the bar. For this reason electrically driven mills run exceedingly smoothly and quietly. While the steam engine with its small inertia can reverse and accelerate more rapidly than any large reversing mill-motor that has yet been put to work, this is merely a question of putting plenty of power into the motor and of keeping the diameter and weight of the armature down. At the same time it is not always wise to reverse a mill too quickly, for when there are three or four stands of rolls coupled together, this tends to break the boxes and spindles, and there is no object gained in reversing the mill in less time than it takes to get the piece back to the rolls. From an actual installation of the Ilgner type it has been found that one ton of four-inch by four-inch billets may be rolled for 24.4 kilowatt-hours of electrical energy. A ton of two-inch by two-inch billets requires thirty-eight kilowatt-hours; one of eleven-inch by six-inch girders, fifty kilowatt-hours. These figures are, of course, variable, depending upon the hardness of the material and the temperature at which the rolling is carried on. One of the latest equipments has already produced from fifty to sixty tons of three-and-one-quarter-inch square billets direct from ingots of two tons in weight, with an energy consumption of twenty-two kilowatt-hours per ton. These figures were obtained when the average production was from twelve to eighteen tons an hour.—*Electrical Engineering (London), April 23.*

Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts will open bids in Washington, D. C., on June 2, for the following electrical material: Miscellaneous fuses and plugs, thirty-eight arc lamps, for delivery at Pensacola, Fla.; two electric motors, for delivery at Boston, Mass.

FINANCIAL REPORTS OF ELECTRIC COMPANIES.

UNITED TRACTION COMPANY.

The United Traction Company, of Albany, N. Y., shows gross earnings for the quarter ended March 31 of $453,777; expenses, $323,799; net, $129,978; other income, $30,977; total income, $160,955; charges, $89,612; surplus, $71,343. For the same period of the preceding year gross was $456,644; expenses, $292,621; other income, $37,641; charges, $87,481; surplus, $114,183.

KANSAS CITY RAILWAY AND LIGHT COMPANY.

The report of the Kansas City Railway and Light Company, of Kansas City, Mo., for the month of March and ten months ended March 31 (June 1 to March 31), shows a March gross of $477,741; expenses, $267,037; March net, $221,704; charges and taxes, $153,824; March surplus, $67,880; a gain of $302 over the same period last year. Ten months' gross, $5,127,918; expenses, $2,658,672; ten months' net, $2,469,246; charges, $1,532,896; ten months' surplus, $936,350, a gain of $32,746 over the same period of last year.

UNITED GAS IMPROVEMENT COMPANY.

The net earnings of the United Gas Improvement Company, of Philadelphia, Pa., for the year ended December 31, 1907, were $6,001,146; dividends, $3,663,136; surplus for the year, $2,338,010. The net earnings are equal to 13.1 per cent on the $15,884,850 capital stock outstanding. The balance sheet shows the following statement of assets and liabilities as of December 31, 1907:

ASSETS.	
Investment in gas, electric street railway, Welsbach and other companies, at cost price	$60,895,974
Uncompleted construction contracts	82,609
Real estate, Philadelphia and elsewhere	1,062,839
Cash	3,321,324
Accounts and bills receivable	1,841,077
Coupons and guaranteed dividends (accrued but not yet due)	518,201
Store room material	112,939
Total	$67,834,966
LIABILITIES.	
Capital stock	$45,884,850
Taxes (accrued but not due)	208,897
Bills payable (time loans made June and October, 1907, for one year)	1,500,000
Accounts payable, due companies in which stock is owned	677,941
Sundry creditors	103,518
Undivided profits invested as above	19,459,759
Total	$67,834,966

At the annual meeting of the company, Rudolph Ellis and William Wood were elected directors to succeed W. W. Gibbs and George Phillier, resigned, and Morris L. Clothier was elected to succeed Samuel R. Shipley, deceased. Other directors were re-elected. The officers were re-elected.

WASHINGTON RAILWAY AND ELECTRIC COMPANY.

The Washington Railway and Electric Company, of Washington, D. C., in its annual report for the year ended December 31, 1907, shows gross income of $3,385,748; expenses, $1,748,752; net, $1,636,996; other income, $43,353; total income, $1,679,349; charges, $1,107,228; surplus, $572,121.

SCHENECTADY RAILWAY COMPANY.

The report of the Schenectady Railway Company, Schenectady, N. Y., for the quarter ended March 31, 1908, shows gross income of $192,828; expenses, $153,382; net, $39,446; other income, $1,386; total income, $40,832; charges, $29,256; surplus, $11,576.

HUDSON RIVER ELECTRIC POWER COMPANY.

The earnings of the Hudson River Electric Power Company for the quarter and twelve months ended March 31 are as follows: Three months' gross, $324,555; expenses, $159,918; three months' net, $164,637. Twelve months' gross, $1,279,179; expenses, $730,054; twelve months' net, $549,125. The statement for the four months ended January 31 shows gross of $486,113; expenses and taxes, $235,173; net, $250,940; interest charges, etc., $199,011; surplus, $51,929.

ROCHESTER RAILWAY COMPANY.

The report of the Rochester (N. Y.) Railway Company for the quarter ended March 31 shows gross earnings of $596,216; expenses, $411,890; charges, $118,908; net income, $185,326; other income, $1,034; total income, $186,360; surplus, $67,452. This compares with a surplus for the same period in 1907 of $105,908.

THE TOPEKA EDISON COMPANY.

The Topeka Edison Company, Topeka, Kan., has filed a report covering the period from July 1 to December 31, 1907. This shows a total investment of $968,816.50, with receipts of $85,364.96. Of this, $39,636.14 came from consumers of electricity for lighting. The expenditures amounted to $68,519.92, of which the manufacturing account consisted of $28,201.85 and the general expenses to $14,310.25. The improvements amounted to $14,184.75.

MASSACHUSETTS ELECTRIC COMPANIES.

The statement of the Massachusetts Electric Companies for the quarter and six months ended March 31, shows gross for the quarter of $1,552,771; expenses, $1,127,720; charges and taxes, $464,316, making a deficit for the quarter of $39,265. This compares with a deficit for the same quarter in 1907 of $117,411. The gross for the period from October 1, 1907, to March 31, 1908, was $3,332,246; expenses, $2,447,783; charges and taxes, $900,752; deficit, $16,289. This compares with a deficit for the same period of last year of $41,890.

THE UNITED RAILWAYS INVESTMENT COMPANY.

The report of the United Railways Investment Company for the year ended December 31, 1907, shows that dividends on stocks owned were paid to the amount of $1,457,772; interest on loans, dividends, etc., $103,092, making the total income $1,560,864. General expenses, interest on bonds, etc., amounted to $1,158,230, making the net income for the year $402,634. Profit and loss credits amounted to $422,282, making a gross surplus of $824,916. The net income is equal to 2.68 per cent earned on the $15,000,000 preferred stock.

The income of the Philadelphia Company and affiliated corporations for the year ended December 31, 1907, shows gross income of $19,082,098; expenses and taxes, $9,668,328; net, $9,413,770; other income, $250,208; total income, $9,663,978; deductions, $1,288,684; balance, $8,375,294; fixed charges, $3,314,234; balance, $5,061,060; improvements, betterments, extensions, sinking fund, etc., $2,136,726; surplus, $2,924,334; dividends, $373,334; net surplus, $2,551,000; proportion to other common and preferred stock of affiliated companies, $3,003; net surplus, $2,547,997. The proportion of the above surplus applicable to United Railways Investment Company based on its present stockholdings (72.80 per cent) of the Philadelphia Company is $1,854,941.

President Thalmann, of the United Railways Investment Company, says in his annual report:

"No dividends in cash or scrip were paid during the year 1907 by the United Railroads of San Francisco, all its receipts over and above fixed charges and expenses, and all the surplus earnings of the Philadelphia Company, above the amount of dividends paid by it, having been retained by the respective companies for their respective corporate purposes.

"During the last fiscal year the most salient feature in the financial history of your company was the strike on the lines of the United Railways of San Francisco. At the date of the presentation of the last annual report of this company, your board of directors firmly hoped that some ar-

rangement, fair and just both to the employés and to the company itself, would be amicably reached, their hope being founded on the facts that the United Railroads of San Francisco had fulfilled the requirements of the decision of the arbitrators fixing a rate of wages for the period terminating May 1, 1907, and that the officers of the United Railroads of San Francisco were prepared to meet the demands of the employés in a reasonable and conciliatory spirit.

"These reasonable expectations of the board were not fulfilled, and a strike on the part of practically all of the employés of the United Railroads of San Francisco began on the fifth day of March, 1907, and lasted approximately six months. As an incident of the strike, the lines of the United Railroads of San Francisco were subjected to a persistent and continuous boycott. Furthermore, the employés were exposed to repeated attacks, and their lives for the greater portion of that period were constantly in danger.

"Naturally, the earnings of that company during this period fell to an extremely low figure, but they have recently regained their former level, as is evidenced by the reports of the monthly gross passenger receipts as furnished to your company by the officers of the United Railroads of San Francisco.

"These reports show that the earnings for the month of March, 1908, were $558,-932, while those shown by the like statements for March, 1907, were $537,700. This comparison furnishes reasonable ground for encouragement as to the future of the United Railroads of San Francisco.

"The consensus of reports received from those familiar with existing conditions in the city of San Francisco justifies a firm belief that the future prosperity of that city is assured, and in that future prosperity there is every reason to believe the United Railroads of San Francisco will fully participate."

NEW ENGLAND TELEPHONE AND TELEGRAPH COMPANY.

The annual report of the New England Telephone and Telegraph Company for the year ended December 31, 1907, shows gross revenue of $10,679,628; operating expenses, $8,513,422; net, $2,166,203; dividends at six per cent, $1,872,817; surplus, $293,386.

The number of stations added to the exchange lists of the New England Telephone and Telegraph Company was 22,-677, making the total at the end of the year 227,861. Including in the account the subscribers of the Southern Massachusetts Telephone Company and those of other associated and sublicensee companies, the total number of stations connected with the system, in Maine, New Hampshire, Vermont and Massachusetts, and in small portions of New York and Rhode Island, was 289,496, as compared with 255,576 at the close of 1906.

Compared with the results of the business for 1906, there was an increase of gross revenue of $1,366,626; expenses increased $1,024,073, and net revenue increased $342,552.

The underground system of the company consists of 2,955,262 feet, about 560 miles, of conduit, containing 14,621,847 feet, or 2,769 miles of duct; 6,919,481 feet of cable have been drawn into the underground system.

The Southern Massachusetts Company has 303,314 feet of conduit, 1,353,839 feet of duct and 424,278 feet of cable.

The expenditure for lines and equipment during the year for new construction was $2,705,814; for repairs and maintenance, $3,346,940; total, $6,052,755, as against an expenditure in 1906 of $6,097,-067.

The total mileage of exchange wire on December 31, 1907, was 418,068 miles.

Exchange and private line stations on December 31, 1907, compare with December 31, 1906, as follows:

	1907.	1906.	Changes.
Exchange stations.....	227,861	205,184	Inc. 22,677
Private line stations...	6,866	7,293	Dec. 427
Total.....	234,727	212,477	Inc. 22,250

The estimated appropriation for maintenance and extension of the property during the year 1908 for new construction and real estate is $1,800,000; for maintenance, including depreciation, $3,300,000; total, $5,100,000.

SAO PAULO TRAMWAY, LIGHT AND POWER COMPANY.

The report of the Sao Paulo Tramway, Light and Power Company for the year ended December 31, 1907, shows gross earnings of $2,111,523; expenses and taxes, $715,650; charges, $359,422; dividend, $691,476; contingent account, $100,000; surplus for the year, $244,975. The surplus after expenses and taxes, and charges, is equal to 12.19 per cent on the $8,500,000 paid-in capital stock.

BUFFALO & LAKE ERIE TRACTION.

The report of the Buffalo & Lake Erie Traction Company for the quarter ended March 31 shows gross earnings of $114,-024; expenses, $83,713; net, $30,311; other income, $2,245; total income, $32,-556; charges, $91,002; deficit, $58,446. This is an increase of $33,000 over the deficit for last year. The general balance sheet shows cash on hand of $24,900, and a profit and loss deficit of $109,028.

Report on Electrolysis.

A pamphlet has been published by Professor Albert F. Ganz, of Stevens Institute of Technology, Hoboken, New Jersey, which gives the conclusions of the Committee on Electrolysis of the American Gas Light Association, which reported in the fall of 1906, and for which committee Professor Ganz was the consulting electrical engineer. This pamphlet also contains Professor Ganz's report to the committee, which explains the theory of electrolytic corrosion, and a lecture which he delivered before the American Gas Institute, at Washington, during October of last year on the general subject of electrolysis. The latter gives a discussion of methods of measuring currents in underground structures and shows the records of certain tests of this character. The results of a number of laboratory experiments, devised to demonstrate the action taking place when a current flows from an underground conductor, are also described.

Professor Ganz concludes that while bonding is the remedy most usually applied for electrolytic corrosion, this increases the tendency for current to flow into the pipes, and no bonding scheme can be applied satisfactorily where the positive zones keep shifting about. Insulating joints can only be used in special cases, and may do more harm than good. The author is convinced there is but little, if anything, that the pipe owner can do to protect his pipes from stray railway currents, and the cure should come from the railways. However, it is difficult to formulate proper restrictions suitable for all conditions, as the amount of current which will flow through the pipes depends largely on the character of the soil. The only really safe condition would be a maximum allowable density of current leaving any one pipe for the ground. This condition would be difficult to determine and to enforce.

The General Electric Company.

The annual meeting of the stockholders of the General Electric Company was held on May 12 at Schenectady, N. Y. Vice-president B. E. Sunny, of Chicago, Ill., was elected a director to succeed Frederick P. Fish, who resigned. The other directors were re-elected for another year as follows: Gordon Abbott, Oliver Ames, C. A. Coffin, W. M. Crane, T. Jefferson Coolidge, Jr.; George P. Gardner, Henry L. Higginson, J. Pierrepont Morgan, J. P. Ord, Robert Treat Paine, Second; Marsden J. Perry, E. W. Rice, Jr.; Charles Steele and S. L. Schoonmaker.

HEATING OF VENTILATED AND ENCLOSED MOTORS.[1]

BY WILSON HARTNELL.

The evolution of the continuous-current electric motor during the last fifteen years has resulted in a gradual decrease in size for any given output without loss of efficiency. The smooth ring wound armatures have been replaced by slotted drum wound. The clearance between the pole-face and the armature is now comparatively very small and the armature notches are wide, necessitating laminated pole-faces. The length of the armature is shorter in proportion to its diameter. In consequence of these changes the magnetic flux in the air-gap has been raised from, say, 4,000 lines per square centimetre to 10,000 or 12,000. At the same time the ampere-turns on the magnets have been decreased and the magnetic leakage reduced to, say, one-fourth to one-fifth of that of the old ring wound motors. The carbon brushes are now run sparklessly in, or nearly in, the middle position, unaffected by reactance voltage or by large field distortion. The modern four-pole motor is at a disadvantage, compared with the old two-pole motors with copper brushes, in respect to dissipating the heat produced in working. The heat produced in the armature and shunt winding is no greater than of old. The heat produced by losses in the teeth and armature discs is serious with a dense magnetic flux in the air-gap, and can only be kept within reasonable bounds by a moderate surface speed of armature. The heat due to the carbon brushes is considerable with low voltages. With a surface speed of 1,500 feet per minute the loss due to friction, and the loss in volts between the carbon and copper, may easily be equal to from one and one-half to one and three-quarter watts per ampere per brush. The heat thus produced can only be dissipated as follows: (1) by heating the motor itself; (2) by radiation; (3) by conduction to a flow of cool air—that is, by ventilation.

It is impossible to separate these cooling effects by ordinary observation, but some assistance may be given by Table I, which shows for a series of motors an assumed average weight, cooling surface, and loss of watts. These data are founded on an actual set of standard motors. There are also tabulated the square inches of cooling surface per watt; the time the motor would require for a rise of seventy-two degrees Fahrenheit (forty degrees centigrade) in temperature, assuming that no heat escaped elsewhere; the cubic feet of cool air per minute that would be required to prevent a rise of temperature exceeding seventy-two degrees Fahrenheit, also assuming that the escaping air were heated thirty-six degrees Fahrenheit, and that no heat escaped elsewhere. The relative change of these valves, as the size of the motor increases, may be seen from Fig. 1. From this it may be inferred that the heating of the motor itself is of practical value when a motor works intermittently, as in a crane or a hoist, say, not running more than twenty minutes per hour fully loaded.

TABLE I.

Size of Motor. H.P.	Assumed Loss in Watts at Full Load.	Area of Enclosed Motor in Square Inches.	Cooling Surface per Watt lost.	Cubic Feet of Air per minute that would Heat the same 72° F.	Weight of Motor	Minutes in which the Motor could Heat the same 72° F.
3	380	1,000	2·6	31	300	113
5	580	1,300	2·2	47	470	100
7½	770	1,600	2·1	63	550	102
10	960	1,850	1·9	79	660	98
15	1,200	2,300	1·8	102	1,000	118
20	1,460	2,650	1·7	120	1,300	128
30	1,900	3,250	1·6	157	1,900	144
40	2,380	3,850	1·5	196	2,500	150
50	2,980	4,300	1·4	244	3,100	140
60	3,570	4,700	1·3	292	—	—
75	4,400	5,100	1·2	360	—	—
100	5,700	5,700	1·0	470	—	—

Radiation—It will be seen that the thick in the larger motor, rendering the escape of heat of the metal proportionately less. Thus, although 2.5 to 2.0 square inches of radiating surface per watt lost may suffice for small enclosed motors, considerably more would be necessary to keep, say, a fifty horse-power enclosed motor equally cool. In order that radiating surfaces be most efficient they must be opposite to cool surfaces, as all surfaces radiate heat in all directions. If there be a steam or gas engine or wall of a boiler-house near the motor, the effective radiation on that side of the motor will be partly neutralized, although the intermediate air may be cool. When an enclosed motor is required of more than, say, three horse-power, the usual means of obtaining the requisite cooling surface is to take a motor of larger size and reduce the output, the armature current being reduced—and, therefore, the armature reaction—and also the flux density in the air-space and ampere-turns in the poles. This reduces the heat due to losses in the copper, and still more the heat due to core losses. By such means the total heat losses are reduced until the cooling surface per watt of the larger motor is sufficient for the diminished outputs. This, however, makes a costly motor for continuous working, even for moderate powers; a twenty horse-power motor wholly enclosed may give ten horse-power at a passable temperature, but a thirty horse-power motor would scarcely give fifteen horse-power for the same temperature rise. A more economical arrangement for an enclosed motor is to place an open motor that may be fully loaded under a tin sheet-iron cover with

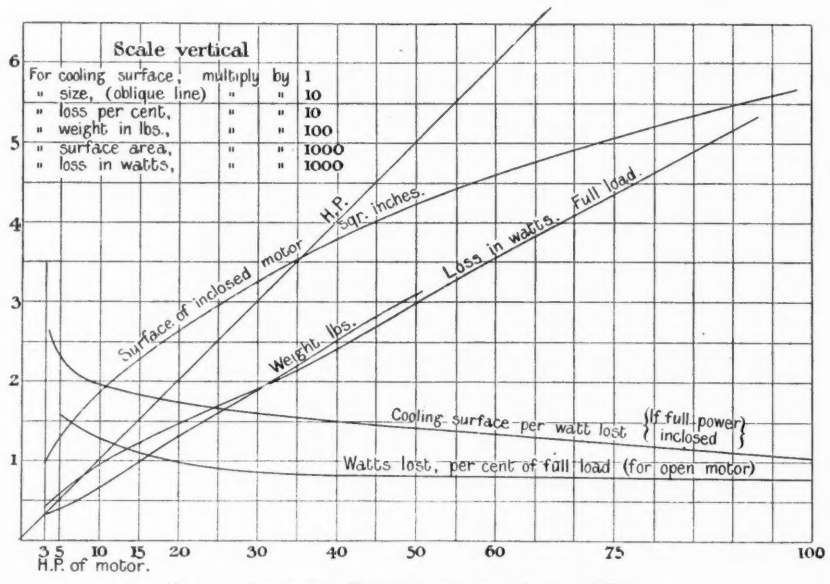

Scale vertical
For cooling surface, multiply by 1
" size, (oblique line) " " 10
" loss per cent., " " 10
" weight in lbs., " " 100
" surface area, " " 1000
" loss in watts, " " 1000
Surface of inclosed motor H.P. sqr. inches.
Loss in watts. Full load.
Weight lbs.
Cooling surface per watt lost (If full power) (If inclosed)
Watts lost, per cent of full load (for open motor)
H.P. of motor.
3 5 10 15 20 30 40 50 60 75 100
1 2 3 4 5 6

FIG. 1.—AVERAGED PARTICULARS OF A SET OF MOTORS.

[1] Paper read before the Institution of Electrical Engineers of Great Britain.

ample inspection doors. This has been found convenient and satisfactory in flour mills, the case, though merely resting on the floor, being practically dustproof and inexpensive. The cover must be roomy because the heated air remains in the upper part of the cover, the lower part remaining cool and, therefore, ineffective as a heat radiator. Examples of open motors working satisfactorily fully loaded, placed in large covered recesses below the ground floor, and also enclosed in what might be compared to large, roomy wooden cupboards, are to be found in our clothing factories, many of which are driven by electric motors throughout.

Ventilation—The cubic feet of air required to keep the temperature rise below seventy-two degrees is probably not less than the quantity tabulated—viz., about nine cubic feet per horse-power per minute for the smaller motors under ten horse-power, and about five cubic feet per horse-power per minute for motors over thirty horse-power. Experience shows that large open motors working to their full load can, by the aid of ventilation and radiation, be kept within the limits of seventy-two degrees. But when wholly enclosed they can only be kept cool by forced draft. From rough estimation it seems that at least double the quantity of air per minute is then required. Electric motors, viewed in regard to their means of cooling, may be divided into eight classes: (1) Entirely open, having their bearings usually on a bedplate which carries the magnets: Suitable for large motors, say over 100 horse-power. (2) Protected open, the bearings carried by open covers at each end of the magnet case: This is the ordinary modern motor, say from 100 horse-power to two horse-power. (3) Enclosed ventilated: The same as No. 2, but with the openings covered by wire net or perforated metal. These are used in factories where the open motor is assumed to be less safe. If the mesh be not less than four per inch the ventilation is not much interfered with, but if the mesh be much less, not only is the ventilation much impeded, but the wirework is apt to become choked with dust and fluff, and the safety of the motor endangered. (4) Same as No. 2 or No. 3, but with a forced ventilation by means of a fan on the armature and a diaphragm or its equivalent to divide the fan suction from the delivery: This is necessary in an exceptionally warm place. (5) Totally enclosed: These are required for special purposes, and usually necessitate a considerable reduction in the output. (6) Covered motors: The same as No. 2 fully loaded, but covered by a roomy thin sheet-iron case, practically dustproof, with openings for oiling and inspecting the brushes, the pulley standing outside the case. (7) Open covered motors: The same as No. 6, but with a smaller cover made wholly or in parts of fine wire netting. The large area of wirework prevents the tendency of any draft to cause the fine mesh to get clogged, and the motor fully loaded would be as cool as if unenclosed. This is specially adapted to textile mills where floating fluff is found. (8) Totally enclosed, but with forced ventilation like No. 4: This is necessary (*a*) when the motor is working in fumes very injurious to the motor, fresh air being sucked into the motor from a pure source through a pipe and discharged near the motor; (*b*) when the motor may be surrounded by inflammable gases, as sometimes in mines, the same air being circulated again and again through the motor and a cooling arrangement. Total enclosure with forced ventilation has been used to cool very large dynamos, cool air being drawn from outside the dynamo house and hot air discharged also outside.

TABLE II.

Standard		As Tested					Rise of Temperature Deg. Fahr.				
Horse-power	Revolutions.	Horse-power	Revolutions.	O = Open E = Enclosed	Volts	Hours on Continuous Test	Air	Field Coils	Armature	Commutator	
1	1,250	3 00	1,080	O	220	6	68	71	85	20	
2	1,250	2 25	800	E	220	6	65	85	87	98	
3	1,250	3 80	780	E	220	10	64	56	75	71	Mean test of 4 motors.
5	1,100	5 00	800	O	220	6	70	53	56	46	
—	—	5 00	843	O	220	9	63	49	47	37	
10	900	10 40	925	O	220	6	55	58	54	51	Mean test of 3 motors.
—	—	10 40	853	O	220	6	67	43	53	55	
—	—	5 00	760	E	220	6	70	59	56	51	
20	800	20 00	800	O	220	9½	63	49	42	35	Mean test of 2 motors.
—	—	10 50	695	E	220	6	71	86	74	73	
40	750	28 00	581	O	105	4½	70	65	70	80	
50	600	59 00	1,096	O	220	8	66	48	69	46	Mean test of 2 motors.
—	—	39 50	455	E	220	6	70	40	56	65	
—	—	20 50	447	E	220	6	73	51	57	82	

The examples given in Table II. of the rise of temperature in motors open and enclosed are taken from records of ordinary tests in the workshop. The motors were of the usual type with decarbonized steel cases and laminated poles, the induction in the poles being from 13,500 to 14,500. In most of the tests the motors drove another motor running as a dynamo whose current helped to drive the motor. Full particulars were taken every half-hour besides occasional temperature observations. All these are omitted so as to confine attention as briefly as possible to the rise of temperature. The rise in temperature with the same motor with the same load in a given time is usually greater when the temperature of the atmosphere is higher. The rise in the temperature of the commutator in a given time under similar conditions can be considerably varied by differences of pressures, width, and quality of the carbons, the best results being determined by experiment. All the above motors had four poles. The particular figures of these tests apply only to the motors tested, but they are in general agreement with tests of other motors. They show the reduced power permissible, if a motor be totally enclosed and continuously loaded. Below three horse-power the loss of power may be inconsiderable. But a twenty horse-power open motor when totally enclosed is but little more than equal in power to a ten horse-power open motor. In the above table it is shown that a fifty horse-power open motor could only give twenty-one horse-power with a permissible temperature of commutator. To obtain the minimum temperature with the reduced output the winding had been specially arranged. In short, while the power of a modern open motor is chiefly a function of its magnetic flux, when totally enclosed the power becomes a function of the area of its casing, considerably influenced, however, by its environment—that is, by the exchange of radiated heat with its surroundings or the motion of the surrounding air.

The increased heating due to totally enclosing a large open-type motor is strikingly shown by the following experiments, and incidentally the increased iron losses due to high speed. The motor was designed for sixty horse-power at 1,000 revolutions per minute in the magnet case of a fifty horse-power motor at 600 revolutions per minute. The ventilating slots around the periphery of the end covers were at first closed. This had been proved greatly to interfere with the ventilation of a large motor, because a cylinder of hot air collects around the inside of the motor although both ends are open. The armature was open, the usual type, diameter 410 millimetres. Slots, forty-eight; size, twelve millimetres by thirty millimetres. The discs (which had the usual core holes) rested on the shaft 4 diameter, The magnetic flux was reduced about fifteen per cent as compared with the standard for 600 revolutions per minute. The armature was at first driven by belt from another smaller motor, and the amperes noted. On running the armature, fully wound, but with the magnets only excited, it was at once noticed that the increase of current on the small motor due to exciting the magnets of the sixty horse-power was much more than anticipated, and that the armature rapidly heated. A series of progressive tests was then made to determine the iron losses. The results are shown in Fig. 2. These curves can only be approximate representations of the true iron losses, as they include other losses which could not be measured. A similar arma-

ture, but unwound, was substituted, and the tests for heating repeated with the same results. The stampings were by Messrs. Sankey with "Insuline" paint on them. The unwound armature was stripped and rebuilt, the stamping equally spaced by ten sheets of tracing paper. On again testing there was no noticeable improvement. The armature discs were again removed, bored, and fixed on a gunmetal bush, the end plates for supporting the

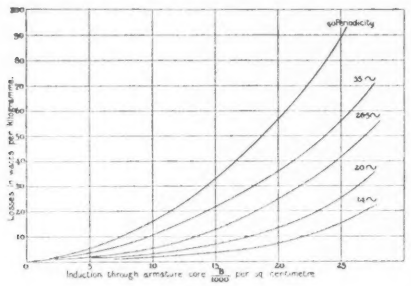


FIG. 2.

Iron losses in C. 500 armature at different periodicities.
Discs thickness 26 S. W. G. (*i.e.*, Standard Wire Gauge = 18 mils) = 0·45 millimetre. They are coated with "Insuline" and rest on the shaft.
Weight of armature core, 81 kilogrammes.
Weight of armature teeth, 21 kilogrammes.
Mean section through teeth under pole-face section through core = 0.7.

end winding were turned thinner, and the cylindrical part for supporting ends of the windings were made shorter and thinner. The end plates were also separated from the stampings by paper discs. This made a slight improvement. After two hours' run with air at sixty degrees Fahrenheit the rise of temperature in the slots was fifty-four and in the centre of the core sixty-six.

The heating being evidently due to the discs themselves, Messrs. Sankey were written to and they sent their curves for the iron losses, which gave no calculated agreement with facts. Finally, the armature was rebuilt with Stalloy stampings and tested unwound, but with the slots filled with wood and the magnets excited. The results are shown in Fig. 3. The rise of temperature in two hours was eight degrees Fahrenheit less than before, showing a slight advantage over ordinary stampings. The armature was wound and a fan fitted to the end of the armature to circulate the air inside. It was then tested as a totally enclosed motor with a load of fifty-eight horse-power for three hours, with the following results: rise of commutotor, 111 degrees; field coils, eighty-eight degrees. It was again tested totally enclosed for eight hours, but with a stop of eight to ten minutes every hour (after the first four hours) to take temperatures. Load, fifty-nine horse-power. The final temperature rises were (air at seventy degrees Fahrenheit): commutator 170, armature 149, field coils 125, air inside 105. Particulars of the rise in temperature are shown in Fig. 4. It will be noticed that there was not much increase of temperature after the first four hours, but the temperatures then were impracticable. The fan was then removed and the motor run at fifty-nine horse-power as an open motor for eight hours with the ventilating slots on the periphery of the end covers also opened; the final temperature rise with the air at sixty-two degrees to sixty-nine de-

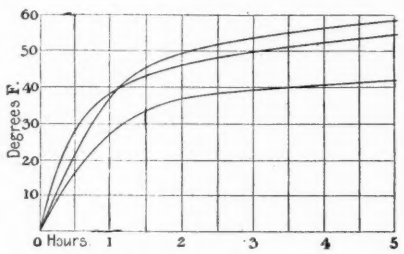


FIG. 3.—HEATING ON TEST, SIXTY HORSE-POWER, 1,000 REVOLUTIONS, UNLOADED, PARTLY OPEN.

grees was: commutator fifty-eight degrees, field coils forty-eight degrees, armature sixty-eight degrees Fahrenheit. It will have been noticed from Table II. that the fifty horse-power motor totally enclosed at about 450 revolutions per minute keeps reasonably cool with 20.5 horse-power. This power probably would be the working limit at standard speed. The cooling surface of the totally enclosed motor per watt lost should be apparently not less than

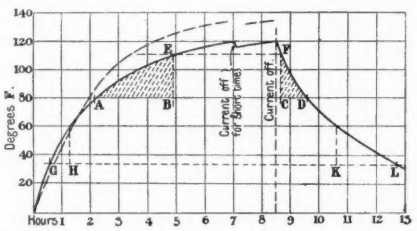


FIG. 5.—HEATING AND COOLING OF A MAGNET COIL.

three and one-half to four square inches; but this depends on outside ventilation. On long tests the temperatures have often been known to go down after three or four hours, due apparently to drafts caused through opening doors.

The heating of the armature at high speeds beyond that given by the usual formula may be in part explained by the formula being founded on experiment that might be indicated by curves, whereas curves indicating the flux changes in the teeth and armature would show a greater maximum and far greater rapidity of change at parts of a complete period. Many measurements of temperature have been taken at intervals of one to two hours, necessitating stopping the motor tested for five to ten minutes. On attempting to plot curves from these measurements showing the rise of temperature, it was obvious that there was a fall of temperature during each interval, especially in small motors, rendering the results of the test useless for the purpose intended. The convex curve (Fig. 5) shows the gradual rise to a maximum temperature of an overloaded field coil of a dynamo (without an armature) and the concave curve the shorter interval of time to reduce the

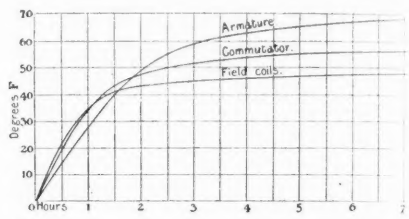


FIG. 4.—HEATING ON TEST, FIFTY-NINE HORSE-POWER, OPEN MOTOR.

higher temperature after the current is cut off. Thus in this curve if any line A B C D be drawn A B represents the time required to rise to a particular temperature B E (measured outside the coil) and C D the time to cool. For the higher temperature which illustrates practical work C D is small compared with A B. The dotted line shows the average internal temperature calculated from the reduced current as the temperature rose. The coil was fully exposed to the air, and it was noticed that the temperature between the

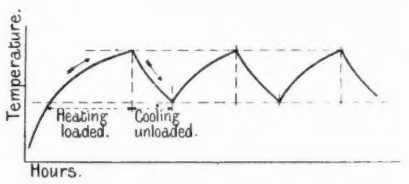


FIG. 6.—INTERMITTENT LOAD.

coil and the magnet ring was the same as outside the magnet ring near the pole. In enclosed motors the outside of the case may at times be twenty degrees Fahrenheit cooler than the magnet coils inside.

The great advantage of intervals of light or no load in the cooling of loaded motors may be roughly judged from Fig. 6, which explains why heavy overload can be borne with intermittent work without undue heating, as in crane motors. This advantageous cooling with intermittent loads can only be obtained when there is a considerable difference of temperature between that of the air and the highest permissible of the motor. If the air be very warm, so that this difference is comparatively

small, the motor gets hot in less time than it cools. It will be seen on Fig. 5 that G H is less than K L. It has often been noticed how a comparatively small opening in a metal cover or (Class 6) enclosing an open motor would reduce the temperature. If the escaping air had a temperature of seventy-two degrees Fahrenheit only one-sixth the quantity given in table would suffice to carry off one-third of the heat, and if the velocity were only two feet per second a moderate opening would suffice. It may be noticed that there is no such thing as a gas-tight motor, even if the shaft worked through a stuffing box. The expulsion of, say, fifteen per cent of the enclosed atmosphere when it was heated, and the entry of the same amount of gaseous air from the outside on cooling, would cause the average condition of the atmosphere outside and inside soon to be similar. To enclose a motor tightly to keep out noxious gases is a delusion. Time forbids any detailed account of experience with the various ways of protecting motors. In an explosive atmosphere they must be totally enclosed and strong enough to withstand an internal explosion as made by the author for a mine some eighteen years ago.

Experience with some motors exposed to various noxious chemical fumes shows that although the motor's appearance may be spoiled and soldered joints affected, yet the motors last so long that it is better to let them wear out and buy new ones rather than put up with the troubles from enclosing them. In the author's opinion the reasons given for totally enclosing any but very small motors (Class 5) are usually mistakes. In the case of insurance risk they tend to defeat the object in view. In nearly every place where power is required for manufacturing, open motors may be used and easily protected against the real or supposed dangers of their particular environment. Enclosed motors with a current of air forced through them either by means of a fan or chimney may be considered as open motors so far as heating is concerned. In order that a continuous-current motor may give the least trouble, it is important that the arrangement be such as to keep the commutator as cool as possible, and *vice versa*. The conclusion is that totally enclosed motors (Class 5) are under great disadvantages, and in general their use can be avoided.

Opening of the Machinery Club.

The club rooms of the Machinery Club, on the twenty-first and twenty-second floors of the Fulton Terminal Building, New York city, were opened on the afternoon of May 21.

What Forestry Has Done.

The forest service of the United States Department of Agriculture has issued a bulletin entitled "What Forestry Has Done." This has been prepared by Treadwell Cleveland, Jr., expert of the department, and reviews the work which has been done toward preserving the forests in Germany, France, Switzerland, Austria-Hungary, Norway, Sweden and Denmark, Russia and Finland, India, Japan, Italy, Spain and Portugal, the Slavic kingdoms, China, Canada and Turkey.

The results accomplished in Germany are most instructive. The German empire has now about 35,000,000 acres of forest, one-third of which belongs to the state; about two per cent to the crown; sixteen per cent to committees, and forty-six per cent to private persons. There is a little over three-fifths of an acre of forest for each citizen, and although fifty-three cubic feet of wood are produced per acre in a year, the imports of wood have increased steadily over exports for over forty years. German forestry is remarkable in three ways: It has always led in scientific thoroughness, and now it is working out results with an exactness equal to that of the laboratory; it has solved the problem of securing, through a long series of years, an increasing forest output and increasing profits at the same time. Germany felt the pinch of wood shortage about 150 years ago, and systematic state forestry was begun. At this time much of the forests had been injured by mismanagement, but under careful treatment the yield has increased at the following rates: In 1830 it was twenty cubic feet per acre; in 1865, twenty-four cubic feet; 1890, fifty-two cubic feet, and in 1904, sixty-five cubic feet. In seventy-five years the forest production has been increased threefold and at the present time only one-sixth of the wood used in Germany is imported. In the United States we are using each year about three times as much timber as the forests produce. The financial returns in Prussia make an even better showing. In 1850 they were twenty-eight cents per acre; in 1865, seventy-two cents; in 1900, $1.58, and in 1904, $2.50. They are now nearly ten times what they were sixty years ago, and are increasing more rapidly than ever.

The French forests have been under state and communal management since 1827. They now yield about forty cubic feet of wood for each acre per year, at a profit of about ninety-five cents. The great achievement of France in forestry has been the establishment of protective forests where much destruction had been caused by floods and wind.

Switzerland has 2,000,000 acres in forest, which yield about forty-five cubic feet of wood an acre annually. Austria has 24,000,000 acres of forest, and Hungary, 23,000,000. Over fifty per cent of these is regulated. Norway has 20,000,000 acres, and Sweden, 50,000,000 acres of forest. While these countries have a forest service, it is not very effective.

Russia has more than 925,000,000 acres in forest, and Finland has 50,000,000. These are protected by law, and even the private forests can be cleared only by permission.

In India there are 119,000,000 acres of forest under state control. Japan has 58,000,000 acres, much of which has been under government control for centuries. Italy has about 10,000,000 acres, most of which is very poor. The existing forests have been practically ruined, and much time and outlay would be necessary to build them up again. Spain has allowed her forests to be destroyed, and now suffers greatly from the destructive floods. Portugal has excellent forestry laws, and is planting large sections of sandy country which is unproductive for agricultural purposes. Of the Slavic kingdoms, Roumania alone has instituted forestry protection. These forests now bring in a good income to the state, the rate being about thirty cents an acre.

China has persistently destroyed her forests. The country has been nearly stripped, and the soil is now completely at the mercy of the floods. China very frequently suffers greatly from floods and water famine. The first step toward relieving this situation is a forest school opened at Mukden.

About one-third of the Dominion of Canada is classed as woodland. This contains 800,000,000 acres, of which, however, only 260,000,000 acres are stocked with commercial timber. A forest office in the Department of the Interior has been established, and has a protective service of fire rangers, and enormous quantities of seedlings are distributed to farmers and others in the prairie regions for planting.

Turkey, in spite of the fact that it has no forestry protection at all, has large forests, due to the fact that they are in very inaccessible country.

This review of what has been done in other countries indicates plainly that this country is enormously behindhand in its expenditure for the management of the forests, and brings out clearly the need for timely action to prevent damage and waste, which can be repaired only at great cost.

COMPARATIVE TESTS OF LIGHTNING-PROTECTION DEVICES ON THE TAYLOR'S FALLS TRANSMISSION SYSTEM.[1]

BY J. F. VAUGHAN.

This paper furnishes data obtained last summer on an operating line experimentally equipped with various protective devices. The results are of especial interest in being actual records made by means of tell-tale papers applied not only to the station protective devices but also to those on the line, and even to the line insulators themselves throughout the system.

When the transmission from Taylor's Falls to Minneapolis, Minn., was built in 1905, local conditions demanded the best lightning protection available. The line ran southwest from the power-house a distance of about forty miles through a rolling country, partly wooded and full of lakes and swamps. It lay in the natural path of thunderstorms forming to the northwest of Minneapolis. Investigation indicated a zone about nine miles long near the middle of the line that was especially subject to severe lightning and the splintering of six poles in different parts of this zone before any wire was strung suggested the necessity for special protection at exposed points against direct stroke.

On account of the wide divergence of opinion on the subject of lightning protection, and the impossibility of reconciling the conflicting results of practice, it was decided to try out on the Taylor's Falls system all existing devices of promise and such others as might be devised, in order, by comparing them in actual service, to work out some effective scheme for future protection.

Description of System—Current is generated by four 2,500-kilowatt, 2,300-volt, sixty-cycle, three-phase water-wheel-driven machines, each operated as a unit, with a bank of three 900-kilowatt transformers connected delta-delta and stepping up to 50,000 volts. The pressure is stepped down at the main substation on the outskirts of Minneapolis to 13,800 volts for local distribution and transmission to a steam and water-power local plant in the city. Automatic time-limit relay oil switches control the lines and transformers at all three plants.

The transmission consists of a single line built on private right of way using Idaho cedar poles of forty-five-foot standard length, carrying three 0000 semi-hard-drawn copper cables supported on fourteen-inch four-part porcelain insulators arranged on a six-foot equilateral triangle with the apex at the pole top. The insulators are supported on iron-pipe pins cemented into them and bolted to the pole tops or set into the cross-arms. The line also carries a pair of telephone wires on an arm 7.5 feet below the transmission arm.

The telephone system consists of a metallic circuit of No. 10 copper mounted on porcelain insulators of the same design as the ordinary double-petticoat glass type. Instruments are permanently connected at the power-house, substation and inspector's cottage at the middle of the line, and booths provided at various points for tapping in inspectors' portable instruments.

Station Protection—For protection of the power-house and substation low-equivalent multigap arresters and oil-insulated choke-coils were installed, supplemented at the substation by a set of experimental aluminum cell-type arresters connected to the entering line through a small number of arrester gaps in zigzag arrangement, set so as to be normally active.

The transformers at all stations were further protected on their low-tension sides by static discharge gaps.

LINE PROTECTION.

Horn-Type Arrester—Three types were installed, one at each end and one in the middle of the line, primarily to pass off disturbances of unusual magnitude, and also to experiment with the different forms.

The substation arrester consisted of a single gap on each phase, arranged with a sheaf of water jets forming series resistance to ground. This required too much water and was replaced by tanks of water with terminals of carbon rods in fibre tubes.

The power-house arrester had two gaps in series between each phase and ground, with the second gap shunted by carbon terminals placed in the river.

The Hugo arrester, at the middle of the line, was built on the selective resistance principle, with three gaps in series on each leg, the second and third gaps being shunted by water-box resistances.

Overhead Grounded Wires—Four types were erected in the nine-mile zone in 0.5 mile lengths, alternating with 0.5 mile length of unprotected line as follows:

Type A—Two wires mounted on a cross-arm five feet apart on either side of the top line wire and about eighteen inches below it.

Type B—Two wires supported on standards of 1.25-inch iron pipe six feet apart and eighteen inches above the top line wire.

Type C—One wire on knobs attached to the pole near the centre of the delta.

Type D—Two wires in the same position as in Type B, but supported on pipe pins set in the ends of a cross-arm attached near the top of the pole.

In the above constructions the grounded wires were of No. 6 hard-drawn copper. The ground connections were of 0.5 inch by 0.0625 inch galvanized iron ribbon wire at every fourth pole and the ground made by 0.75 inch galvanized iron pipe driven to moist ground.

Lightning-Rods—Four types were used, erected in the nine-mile zone in sections from one to two miles long, separated by unprotected sections as in the case of the grounded-wire constructions as follows:

Type A—Rods of 1.25 inches galvanized iron pipe attached to the poles and extended by tridents of copper wire reaching six feet above the top line wire.

Type B—Rods of 1.5 inches galvanized iron pipe mounted on separate poles twenty feet to one side of the transmission line and topped by tridents of copper wire extending twenty-five feet above the top line wire. Rod poles were spaced at the centres of alternate spans.

Type C—Same as Type B, but spaced three rods to four spans.

Type D—Same as Type B, but spaced 1,000 feet apart.

Ground connections were made as on grounded-wire construction, but with two grounds for each rod pole, one at the base of the pole and the other twenty feet or more away, to insure especially wet ground and to increase the discharge area.

Telephone Protection—Each permanent and temporary telephone connection was made through a one-to-one repeating coil and discharge gaps to ground set to break down at about 900 volts.[1]

Recording Devices—All station arresters were provided with tell-tale papers. To determine the character of disturbances, their extent, magnitude, and effect on line and apparatus, ground connections of all protective devices were provided with gaps for the insertion of tell-tale papers.

To study the stresses on the line insulation throughout its length and the behavior of the insulators, each insulator pin at every third pole was grounded

[1] Abstract of a paper presented at the annual meeting of the American Institute of Electrical Engineers, New York, May 19, 1908.

(1 American Tel. and Tel. Co. Protection 74—A.)

through a separate ground wire and tell-tale box, supplemented by choke-coils shunted with tell-tale gaps cut into the line wires at various points.

After a number of insulators on grounded pins had been damaged, the pin grounds were removed from four sections of about one mile long each, separated by one-mile sections left grounded, to prove whether the grounding was in any way responsible for insulator failures.

Records—The following records were kept:

A—Weather conditions shown by United States Weather Bureau reports, and reports of observers along the line.

B—Storm occurrences and data furnished by local men in charge.

C—Operating and special reports of interruptions to service and damage to system.

D—Tell-tale papers collected after each storm.

E—Graphic analysis of tell-tale papers for each storm.

Operation and Results of First Season—The transmission system was started up in December, 1906, and lightning protection records carried through the following summer. The lightning season opened late in March and lasted into October. Thirty-two storms occurred during this season within reach of the line. In seventeen the service was interrupted and eight of these storms caused damage to insulators, while only one storm affected the station apparatus; this was due probably to a defect in a transformer bushing, but was not sufficient to interrupt the service. Out of forty-two insulators damaged, only three were punctured, the rest being shattered.

The accompanying tabulation further analyzes insulator damage.

The chief operating troubles were interruptions due to short-circuits and grounds from spilling over of insulators, generally accompanied by permanent damage to a part of such insulators. Another serious cause of interruption during the latter part of the season was due to too low a setting of the horn arrester at the power-house; this did not appear with the higher setting earlier in the season.

ANALYSIS OF RECORDS.

Examination of the records indicates that:

Points where the line was especially liable to damage are, first, exposed heights and, next, wet bottom lands.

Damage was usually concentrated within a distance of a mile or two, with the exception of the two storms of June 30 and August 6, in the latter of which the storm crossed the line at a slight angle; and in the former, although there is no record of the direction of travel of the storm, there are indications that it traveled along the line for some distance.

Thus far, trouble has not been confined to any defined points on the line, but as yet there is insufficient conclusive evidence on this point.

The record of line failures appears to show that:

Where grounded and ungrounded pins come on adjacent poles, damage to the insulators generally occurred at the grounded pin, but the damage of a group of insulators on a section of line where all grounds had been removed and on pole 1,065 indicates that grounding the pins probably did not materially increase the danger of damage.

Top insulators are somewhat more liable to damage than those on the sides and those on the brace side are apparently somewhat more affected than those on the opposite side.

Overhead grounded wire construction materially protects insulators. The lightning-rods do not seem to have much effect except in cases of direct stroke.

The one case of pole splitting was a pole with no ground connection.

Examination of the tell-tale papers and graphic charts made indicates that:

Storms follow no well-defined paths, nor are their effects confined to any particular part of the line.

Stresses do not occur at any definite points.

Principal disturbances are due to immense static charges on the line in the immediate vicinity of storms. These charges are of great intensity and concentration, frequently spilling over a number of insulators without traveling along the line more than a few hundred feet.

The disturbances are confined to areas extending from one-half to two miles along the line, excepting where storms are traveling parallel to the line, as in the storm of August 18, which suggests recurrent and decreasing activity as the storm passes down the line. Even in this case no area of disturbance was over three miles in length.

In general, the protected nine-mile zone shows an appreciable decrease of insulator stress and activity of devices for distance storms and a very decided shielding effect of overhead grounded wires as well.

The effectiveness of the various types of overhead grounded wire appears to be in proportion to their theoretical value, the wires well above the line being the best and the wire in the centre of the delta the worst. The activity of the lightning-rods, especially those at the side of the line, is marked. In one storm, one of type "B" rods passed off a discharge which can be accounted for only by discharge between cloud and ground. This

ANALYSIS OF INSULATOR FAILURES.

Total number of storms	32	
Number damaging insulators	8	
Total number of insulators on line, approximately	5,500	
Number damaged	42	0.8% of total damaged
Number shattered	39	92.9% " " "
Number punctured	3	7.1% " " "
Number top insulators	23	54.7% " " "
Number on west side	6	14.3% " " "
Number on east side	13	31.0% " " "
Number on brace side	12	28.6% " " "
Number on opposite side	5	11.9% " " "
Total number insulators on grounded pins, approx.	1,650	30.0% " "
Total number insulators on ungrounded pins, approx.	3,850	70.0% " "
Number damaged on grounded pins and towers	35	83.3% " " damaged
Number damaged on towers	3	7.2% " " "
Number damaged on ungrounded pins	7	16.7% " " "
Number damaged in sections where grounds had been removed	4	9.5% " " "
Number damaged on more or less exposed heights	28	66.7% " " "
Number damaged in wet bottoms	8	19.0% " " "
Number damaged, scattering	6	14.3% " " "
Number damaged under overhead grounded wires. (At or near ends only)	2	4.8% " " "
Number damaged under lightning rods on poles	3	7.2% " " "
Number damaged under lightning rods on separate poles	0	0.0% " " "
Poles split.		
Number with pin grounds	0	
Number without pin grounds	1	
Poles burned.		
Number with pin grounds	2	
Number without pin grounds	0	

is of especial interest, as a lightning flash photographed by one of the inspectors the previous season showed ramifications apparently covering a territory a mile or two in diameter, emphasizing the necessity for some such protection.[1] This pole may have received a branch of such a direct stroke and in any case shielded the line from any unusual stress at that point.

The station arrester records on the graphic chart show the low-equivalent type of arresters to have operated according to their theoretical design; but whether the volume discharged was sufficient to keep down dangerous potentials is not certain, since in each important case the simultaneous and vigorous operation of the power-house horn arrester outside the station indicated that it took the brunt of the discharge. The cell-type arrester was apparently more sensitive and operated more freely than the other types. There is no record, however, to show its action in disposing of abnormally heavy discharges. On the other hand, it appeared to be more sensitive in responding to strains due to a grounded line, and discharged for considerable periods under this condition without damage. The operation of the horn arresters, especially at the power-house, has been very promising and appears to fulfil their intended function as an emergency device. Their operation has been chiefly when the line was grounded by the failure of an insulator, but there is one case where the power-house horn arrester discharged over both gaps in series without any indication of discharge through the water shunt of the second horn; this indicates that it passed off a high-frequency static discharge without allowing the line current to follow. But this single case is not conclusive. There are other cases, however, which show the passage of heavy disruptive discharges which indicate that these types have handled high-frequency disturbances as well as low-frequency surges. From their action so far it is believed that the two and three-gap types of horn arresters will be effective in handling occasional disturbances whether static or dynamic which might otherwise be of too great magnitude for the station arresters to dissipate, and that this can be done with settings which will not interrupt the line nor necessarily disturb synchronous apparatus.

The telephone line ordinarily operated quietly, but, although often too noisy to use in case of line trouble, it was, as a rule, kept from damage by the protectors and recovered when the line cleared up. The effectiveness of the protectors was well illustrated during a ground on one phase by the immediate burning out of two instruments not protected, while a protector on the third instrument discharged freely with no damage to the instrument.

[1] See Transactions A. I. E. E., Vol. xxv, pp. 901 to 926.

CONCLUSIONS.

The results of the Taylor's Falls experiments so far indicate that:

The principal trouble is from temporary or permanent breakdown of line insulation by static charges induced in the line by passing storms.

Direct strokes between cloud and ground may occur at any time. Although there were several cases of damage so caused during construction, the first season's operation gives evidence of only one case, and that without damage.

The induced charges are highly concentrated, and often of immense volume and intensity, discharging to ground over insulators with a disruptive effect that tends to shatter but rarely to puncture them, often without line current following. Line current may or may not follow these discharges; if it follows, it may only temporarily ground or short-circuit the line.

Arcs established by insulator spill-overs or leakage of charging current through damaged insulators may burn pole structures or further damage insulators and even fuse the line wire.

Such disturbances may occur anywhere on the line, but with a preference for exposed heights and to a less degree to wet lowlands.

There is no evidence of surges other than the direct effects of grounds or short-circuits, nor of stress at any definite points on the line such as from reflected or standing waves.

Top insulators, and to a less extent those on the cross-arm-brace side of the pole, apparently are more liable to damage, although the cases are not sufficiently frequent to be conclusive.

Grounding of insulator pins by tower structures or otherwise has comparatively little effect in assisting insulator breakdowns.

Overhead grounded wires are of decided value in shielding the line from induced static charges and in preventing insulator breakdowns.

In the only case of direct stroke, the lightning-rod pole alongside the line was effective in preventing line damage.

A grounded conductor running down the pole is of decided value in preventing splintering of the pole.

The selective resistance, multi-gap type of arrester is effective in disposing of ordinary disturbances.

The aluminum cell-type arrester is, in general, more sensitive and freer in discharge; it gives great promise for station protection.

Horn arresters of the series gap and selective resistance type are fairly sensitive to static discharge as well as to disturbances of lower periodicity, and of special value as emergency devices to relieve the station arresters in case of abnormal discharge. They may be adjusted to be fairly sensitive without interrupting service or necessarily throwing out synchronous apparatus.

The use of the tell-tale-paper system is essential in following the action of station protective apparatus, and is of decided value in studying line stresses and the effectiveness of protective devices.

The results of the above experiments have led to the recommendation that the overhead grounded wire construction be immediately extended about fifteen miles in sections covering both ends and the more exposed parts of the line; that the use of horn arresters be continued and further adjustments studied; that the rest of the station and line protective apparatus be left as it is, and that the present system of tell-tale paper and other records be continued during the coming season.

Fire Underwriters' Report on the Condition of the Fire-Alarm System in the Borough of Manhattan, New York City.

In conformity with a resolution adopted at a joint meeting of the Underwriters' organizations, the Merchants' Association and the Commissioners of Accounts, held on February 7, 1908, and in pursuance of the instructions of George W. Hoyt, chairman of the Committee on Fire Prevention, of New York city; the late fire commissioner, the Hon. Hugh Bonner, and also by the present fire commissioner, the Hon. Nicholas Hayes, the Committee on Fire-Alarm Service of the New York Board of Fire Underwriters has investigated the present condition of the fire-alarm telegraph system of the borough of Manhattan, New York city. The committee's report has just been made public.

The committee announces that it has studied the report upon this system made

to the New York Board of Fire Underwriters on September 12, 1905, and has made thorough and independent checks, tests and investigations in order to determine whether the present conditions are substantially as reported at that time. The results of the 1905 investigation were reported fully in the issue of the ELECTRICAL REVIEW for October 14, 1905.

The committee has also made a survey of the fire-alarm headquarters building and examined all of the apparatus, cables and wires contained therein. Elaborate tests were made upon all the circuits composing the system, and the official records of troubles have been tabulated and analyzed. The condition of the fire-alarm boxes, the test boxes, the underground cables and the overhead cables has been examined, and a study has been made of the general arrangement and design of the system. Great care has been taken to ascertain with certainty the degree of improvement which may have been accomplished in the system by reconstruction or repairs. As the result of this, the committee finds that only small changes have been made, and that these changes are of such a nature that they have not substantially improved the system as a whole.

A map in colors is presented as a supplement to the report, indicating the area in the borough of Manhattan which is inadequately protected by the present service. This section comprises about three-quarters of the area of Manhattan Island south of Fifty-ninth street. The boxes within this district are dependent for their operation upon a cable which is in such a precarious condition that it may at any moment be destroyed at any one or scores of vulnerable points. The interruption of this one cable would put out of service all the boxes shown within this area, leaving only a few isolated boxes, which are indicated in other colors. The financial, chemical, printing, leather and wholesale dry goods districts would be left without fire-alarm service, as every box in these districts is dependent upon some conductor in this cable. On Manhattan Island south of Fifty-ninth street there is at present a total of 508 boxes. Of these, 363 would be put out of service by the interruption of the one cable in question. The region dependent upon this single cable contains the most dangerous conflagration hazards in the city of New York.

The general tenor of the report is simply a reiteration of faulty construction and indeterminate hazards. From the report it is apparent that only because the operators are signally competent, and understand the abnormal workings of the system rather than the normal workings, the present degree of operativeness of the system is possible. The report states that it is dangerous even to make a test upon the wires in most of the terminal posts on account of the grave liability to derangement which exists even when the wires are handled with care. The report emphasizes the fact that nothing but a radical reconstruction can remove the hazards which these points constitute.

Appendix A comprises a report on the present organization, equipment and operation of the fire-alarm system, together with the improvements since September 1, 1905. On September 1, 1905, the cable system consisted, roughly, of 154 miles of cable, containing 1,483 miles of conductor. Of this amount thirty-five miles of cable, containing 372 miles of conductor, had rubber insulation, and the remaining 119 miles of cable, containing 1,110 miles of conductor, had fibre insulation. From September 1, 1905, to March 1, 1908, the department installed thirteen miles of cable, containing 172 miles of conductor having rubber insulation. During the same period about nine miles of cable, containing ninety-one miles of conductor, mainly with fibre insulation, was removed from the system. On March 1, 1908, the cable system consisted of about 158 miles of cable, containing 1,563 miles of conductor. Minor changes have been made in the boxes, in the instruments, in the fire houses, in the central-office apparatus, and in 1906 the New York Telephone Company installed and now maintains a three-position telephone switchboard with capacity for 180 circuits connected to the Plaza exchange through eleven trunk lines.

Appendix B is a report on the tests and troubles. The tabulation shows that all of the circuits have had some trouble during both 1906 and 1907. In 1906 the smallest number of troubles on any one circuit was five, while the largest number was sixty-seven. In 1907 the smallest number of troubles on any one circuit was four, while the largest number was fifty-three.

Appendix C contains notes on the present condition of cables in manholes and flush boxes mentioned in appendices A and C of the 1905 report.

Appendix D contains notes on the present condition of cable terminals and test posts mentioned in appendix B of the 1905 report.

Appendix E contains photographs and notes concerning the condition of cables in terminal posts, test boxes and flush boxes not mentioned in appendices C and D.

Appendix F contains notes on conditions of cables in terminal posts, test boxes, manholes and flush boxes, not photographed, which were not mentioned in the 1905 report.

Appendix G contains notes on the present condition of the cables on the Third and Ninth avenue elevated railroad structures.

Telephone and Telegraph Companies.

At present the three large telephone and telegraph companies, the American Telephone and Telegraph Company, the Western Union Telegraph Company and the Mackay Companies, says the *Wall Street Journal*, have outstanding a total of $343,682,280 stock, which, owned by upward of 45,000 shareholders, shows an average investment of over seventy-five shares per stockholder.

Of this total of 45,000 shareholders, more than half, or, to be exact, 24,400, comprise the owners of the $152,484,855 outstanding stock of the American Telephone and Telegraph Company. The average investment holding of telephone stock is 62.4 shares. Western Union is nearly as well distributed, its 14,500 shareholders owning an average of 68.8 shares each. The situation with the Mackay Companies is somewhat different, and indicates that the efforts to attract investors to the stock have been only partially successful. On March 17 the company had a total of 6,690 individual shareholders, an average investment of 130.5 shares, showing about half the distribution of American Telephone stock. It should be remembered, however, that the Mackay Companies is the newest of the three companies, having been organized but five years ago, in 1903.

The comparative figures of the three companies are:

	Stock Outstanding.	Stockholders.	Av. per Holder.
American Telephone	$152,484,855	24,400	62.4
Western Union	99,817,025	14,500	68.8
Mackay Companies	91,380,400	6,690	130.5
Total	$343,682,580	45,590	75.3

Canadian Electrical Convention Postponed.

The eighteenth annual convention of the Canadian Electrical Association, which will be held at Toronto, Ontario, has been postponed for one week. The new dates are Wednesday, Thursday and Friday, June 17, 18 and 19.

PHOTOMETERS.

BY JOSEPH H. HART.

The subject of photometry is a rather important one to the electrical engineer and the central station manager, as well as to the investigators in the modern problem of light and its production. Aside from the importance of photometers in the theoretical investigation and measurement of illuminating power of lamps, there is a distinct use for such instruments in electrical plants which install their own lighting systems, or at least supply customers with lamps. These invariably desire lamps giving the best illumination for a given cost and power consumption and having the longest life, and photometers in this field have a certain definite importance in the selection from the various lamps on the market. This use is not as extended as it might be with profit, owing to the fact that users very often take lamps from the manufacturers on their statement of efficiency and capabilities without special verification.

A photometer is such an easy machine to operate with fairly approximate results that it is surprising that it has not come into more general use in this field. The reason for this is easy to understand. In spite of the fact that there are over six dozen different photometers manufactured, each on a practically different principle or design, not one of these can be said to be thoroughly satisfactory from an operative point of view. Of this total number some give greater or less satisfaction, but when it comes to accurate measurements or extremely rapid ones, all photometers fail almost utterly. Thus it is impossible even in this field to test all lamps by a photometric standard. Test lamps only can be taken at random from a consignment, but these do fairly well. It is in the field of accurate measurements only that photometers have attained such a bad name which has been noted, and has its influence over all other applications. Thus, photometers as physical measurement instruments are very inaccurate, and is rivaled only in this regard by instruments in one other line of measurement, namely, heat. In comparison with the ordinary instruments of precision common in the great majority of modern developments, the photometer is hopelessly inadequate.

Undoubtedly, the reason for the lack of progress in investigations in regard to the nature and character of heat and light can be traced to a common source—the inadequacy of the measuring instruments at hand. Photometers, however, are not wholly to blame as poor measuring instruments. The problem they are asked to solve is in reality twofold. They must not only measure light accurately, but must also diminish the inadequacy of the eye in reading measurements. The problem from a theoretical, as well as commercial, viewpoint is also twofold: first, the nature and efficiency of production of light whenever obtained and, second, its illuminating power. Light consists of transverse waves in the ether, and of all waves of this character which it is possible to produce only a small percentage is at all visible to the eye. The situation would have its analogue in sound if of all the musical notes capable of production on a piano only one octave could be heard. Further, these waves are invariably produced by an indirect process in commercial work to-day, namely, by the production of intense heat with light which appears to be merely a by-product of this production.

The second part of the problem is even more complicated. It involves the utilization of light for various purposes in various locations, and under various conditions, and in this department the nature of the human eye enters as an important factor. As an illustration of this, the Cooper Hewitt light may be cited. It is produced by practically the most efficient process known for the production of light, but in the great majority of cases it becomes useless for illuminating purposes on account of the character of the light. This latter condition is true in many more cases than is ordinarily understood. Thus, the rapid radiation from a steam radiator is in reality light, and fails in its purpose simply on account of the inadequacy of the human eye to perceive it. Again, even granting the production of a light perceivable by the human eye, the question of its pleasing effect and its non-fatiguing effect when used by the eye for various purposes enter as equally important factors.

Now in the measurement of these different lights which have and can be produced for illuminating purposes, photometers are almost the sole instruments of measurement. They are undoubtedly poor instruments in comparison with the instruments of precision in almost every other field, but they are the only known devices at hand to-day for this purpose. Heat measurement is not so complicated as that of light, but heat and light are closely allied and the causes for poor results are practically and fundamentally the same in both cases.

It is almost useless to go into a full explanation of all the different photometers in existence at one time or another on the market or to understand their methods of operation. The fundamental principles in most common use are dependent, first, upon the dispersion of light with distance, owing to its radiation from a centre; second, the absorptive power of different materials for light. Both of these methods have been exploited innumerable times in various devices with uniform non-success for the purpose desired. So many features enter to influence these principles in accurate measurements that they never give more than approximate results. As an illustration of the limitations of the first system can be mentioned the absorptive power of the medium, the nature of the surface upon which the light falls, and, the most important of all, the color of the light. The invention of the flicker photometer by Professor Rood, of Columbia University, a number of years ago, was hailed by many as the advent of a new era of photometric measurements. The result of the invention of this machine has merely tended, however, to complicate matters and add additional problems. Apparently the chief question in comparing the intensity of two lights seemed to rest upon the fundamental question of difference in color that is always perceivable. The flicker photometer seemed to eliminate this, but its fatiguing effect upon the eye and the question of producing mechanism that always turns the same amount of light toward the eye without variation in distance were such that it is not satisfactory. Further, it was found that the fatiguing effect introduced new complications. Color-blind people were able to see the flicker often when produced by light invisible to them. Further complications have arisen in the use of this device which have led the majority of scientists to attempt to develop new instruments based on entirely different principles. As an illustration of this, and as showing the progress in this field, the problem has been divided into, first, the production of radiant energy, and second, its transformation into light. Instruments have been developed for fairly accurate measurements of this quantity. Thermopiles, bolometers, radiomicrometers and a large number of similar instruments are in existence to-day for the accurate measurement of radiant energy. The problem is divisible, first, into the production of radiant energy by the most

efficient process, and, second, the transformation of this radiant energy into a form visible and useful to the human eye. Methods of producing radiant energy are increasing enormously. Wireless telegraphy is one of these forms in which an enormous amount of radiant energy is used.

Second, the transformation of these forms of energy into light is gradually nearing solution. The laws governing phosphorescence and fluorescence are becoming more generally known phenomena, and the laws governing their production are beginning to be understood. The breaking down of certain wave-lengths into others is known to occur under all circumstances. The problem is now merely the transformation of waves of certain wave-lengths into waves of desired wave-lengths.

Further, the complexity of the human eye is receiving attention. It is now known that the eye requires for best utilization certain wave-lengths for a certain purpose and certain other wave-lengths for other purposes with best efficiency. Thus, the retina of the eye has been investigated and certain portions of it respond to feeble illumination, and others to intense illumination. The fatiguing effect of certain kinds of light and the cause of this are now known. What was formerly a complicated problem is to-day resolved into several with comparatively easy solutions.

The photometer as it exists to-day has in reality ceased to possess the importance that it had a decade ago. For commercial work of the character mentioned at the beginning of this article, almost a score of different photometers are very satisfactory. Their use is a very real one in this field, and their choice is dependent almost absolutely upon first cost and ease of operation. Formerly the photometer was constructed for two purposes—the one here mentioned and with the further idea of providing an accurate instrument of research. This latter field is gradually disappearing. This limitation permits improvements in mechanism and its use for the other processes hitherto unconsidered. When the photometer is to be used at fairly long intervals, some form of the flicker photometer appears likely to be eminently satisfactory. Devices for obtaining a mean spherical candle-power have also appeared objectionable in the measurement of electric light. With the development of the latter there is no doubt that photometers should undergo a marked development to a satisfactory state, with a rapid increase in the number of instruments in efficient use. It should be recognized that photometers by their very nature are inaccurate to within five per cent at least, on the average, and that their field of usefulness for other purposes has been removed, and that these conditions are now of minor importance, and are not extremely undesirable. With the photometer gradually attaining its place as a commercial instrument for a definite purpose, it ceases to be the unsatisfactory development it formerly was, and should come into more general use.

THE SEMIANNUAL MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

DETROIT, MICH., JUNE 23-26.

The semiannual meeting of the American Society of Mechanical Engineers will be held in Detroit, Mich., June 23-26. An entire session will be devoted to papers on the conveying of materials, when hoisting and conveying machinery, including belt conveyers, the use of conveying machinery in cement plants, etc., will be discussed.

Among other subjects which will be taken up by professional papers are: "Clutches," with special reference to automobile clutches, by Henry Souther; "Some Pitot Tube Studies," by Professor W. B. Gregory, of Tulane University, New Orleans, La., and Professor E. W. Schroder, of Cornell University; "Thermal Properties of Superheated Steam," by Professor R. C. H. Heck, of Lehigh University; "Horse-Power, Friction Losses and Efficiencies of Gas and Oil Engines," by Professor Lionel S. Marks, of Harvard University; "A Journal Friction Measuring Machine," by Henry Hess, of Philadelphia; "A Simple Method of Cleaning Gas Conduits," by W. D. Mount; "A Rational Method of Checking Conical Pistons for Stress," by Professor G. H. Shepard, of Syracuse University, and "The By-Product Coke Oven," by W. H. Blauvelt.

A lecture on "Contributions of Photography to Our Knowledge of Stellar Evolutions" will be delivered by Professor John A. Brashear, of Allegheny, Pa. The usual receptions will be held and excursions will be made to manufacturing plants, the ship-building yards and various points of interest in and around Detroit. Among the excursions planned is one to the University of Michigan, at Ann Arbor. The gas power section of the society will hold a session, and the Society for the Promotion of Engineering Education and the Society of Automobile Engineers will hold a meeting in Detroit at the same time.

Electric Railways in Indiana.

The report of the Indiana Bureau of Statistics for the year ended June 30 last on electric railroads in the state, including both street and interurban lines, shows that there are thirty-one street and interurban systems in the state, and during the year, as shown by their reports, seventeen succeeded in creating surplus funds out of their earnings, while fourteen had deficits. Eight systems reported that they had paid dividends on their stock.

The total number of passengers carried in 1907 was 152,016,610, of which 28,082,487 were carried on interurban lines, and 123,934,123 on city lines. The total number of passengers carried in 1906 was 127,616,952.

The gross earnings of all companies in 1907 was $10,378,939.76, and in 1906, $8,172,775.72. The grand total expenses in 1907 were $6,407,103.19, and in 1906, $5,551,456.50. The net earnings in 1907 were $3,071,836.57, and in 1906, $3,161,319.22. The earnings from freight in 1907 were $419,295.51, and in 1906, $299,199.18. The earnings from passengers in 1907 were $9,240,409.82, and in 1906, $7,639,506.23. The amount spent for additions and betterments in 1907 was $806,242.21, and in 1906, $702,866.02. The amount expended in taxes in 1907 was $451,193.51, and in 1906, $456,241.70.

The total number of employés of interurban and street railway companies in 1907 was 7,654, and in 1906, 4,095. The total compensation of all employés in 1907 was $3,287,104.48, as against $2,524,475.08 in 1906. The average wage a day, taking all classes of employés into consideration, was about the same in 1907 as in 1906.

The total compensation of motormen in 1907 was $697,616.24, and the compensation of conductors was $678,466.26. Approximately 2,200 motormen and conductors were employed during the year.

The average fare on city lines in 1907 was 3.6 cents; on interurban lines the average fare was 16.6 cents.

Address on Continuity of Education.

An address will be delivered by Frederick P. Fish before the graduating class and the alumni of the schools of Mines, Engineering and Chemistry of Columbia University, New York city, at 3 P. M., Tuesday, May 26, in Havemeyer Hall. The subject will be "The Continuity of Education."

Electrical Papers at the London Physical Society.

At the meeting of the Physical Society, of London, on March 27, with Dr. Chree in the chair, a number of interesting electrical subjects were considered. The first matter was the exhibition by Dr. C. V. Drysdale of "A vacuum tube apparatus for demonstrating the propagation of alternate current waves in cables." The propagation of alternate current waves in conductors has been frequently exhibited by the aid of a helix, notably by Professor Fleming and Dr. G. Scibt, and the former has proposed the use of vacuum tubes to show the distribution of potential. The author had noticed that in a tube laid parallel to the helix the brightness was proportional to the slope of potential and hence to the current. The apparatus therefore consisted of a wooden stand which supported a helix about six feet long, a vacuum tube just above it and a series of eighteen vertical tubes below it. On feeding the helix from a high-frequency resonance circuit nodes and loops of potential and current were simultaneously visible in the two sets of tubes, and these were approximately in quadrature with one another. Experiments were shown in which the frequency of the supply was varied, and the capacity of the helix was altered by introducing an earthed wire inside it. Resistance, capacity, and inductance were also connected successively to the receiving end, and the effects were approximately in agreement with theory.

W. Duddell asked why the points of zero potential were not more clearly marked. Was it due to absorption of energy by the tubes or to the superposition of oscillations with higher frequencies? Had the author used a single long tube with a strip of tinfoil on the outside? He also asked what gas the author used in the vertical tubes, and whether he had tried helium.

Dr. Drysdale in reply said that the tubes were filled with CO_2. It was somewhat difficult to insure their equality, and no attempt had therefore been made to use rare gases. Doubtless still better results could be obtained, but the CO_2 tubes were sufficiently bright for most purposes. He believed that the energy taken by so many tubes was the cause of the absence of complete darkness at the nodes, as with a single tube sharper results had been obtained. For this reason the single tube with a strip of tinfoil on the side had not been used.

Dr. Drysdale next read a paper entitled "Notes on the Plug Permeameter." The author briefly described the instrument, in which a drill is employed to cut a conical hole in a casting or forging, at the same time leaving a pin 0.1-inch diameter standing in the middle. A wrought-iron plug carrying a bobbin with magnetizing and search coils completes the magnetic circuit, forming a miniature permeameter. The readings are taken by means of an ammeter and ballistic galvanometer in the ordinary way, or by the aid of a portable direct-reading test set. When this instrument was first described it was found, as would be expected, that the values of the induction given by it were too low, and it had been supposed by some that this was due to imperfection in the magnetic joint. The author, on the other hand, had attributed it to end effects and to the shortness of the specimen. Investigations had been made confirming this view, and showing that the amount of this end effect could be fairly closely compensated by correcting the value of H in the same ratio for all specimens. These investigations had been carried out by obtaining some rings of cast and wrought iron and steel, testing them by the ring method, and afterward cutting them into quadrants which were drilled and tested with the plug. Curves were given showing the results obtained by the plug permeameter when the instrument had been empirically calibrated from the foregoing tests. These showed that the instrument was accurate within two or three per cent, which was as satisfactory as most other permeameters.

Professor S. P. Thompson said the author's instrument commended itself for its usefulness and ingenuity. He would like to know how far its results were comparable with those obtained from ring and double yoke methods. He was not sure that the author's explanation that the discrepancies were due to end effects was the correct one. In drilling the hole in the casting the magnetic properties of the iron were altered and the hysteresis increased.

A. Campbell remarked that from his experience of several varieties of permeameters he was not at all surprised to find that Dr. Drysdale had had to calibrate his permeameter by the purely experimental method of comparison with the trustworthy ring method. By averaging the different calibrations given by various types of material he appeared to be able to obtain fairly good results, but there were other permeameters which gave satisfactory results without any empirical calibration.

A. Russell said he appreciated the ingenuity displayed in the Drysdale permeameter. He suggested the following as the probable cause of part of the discrepancy between the magnetization curves got by the ring method and by the permeameter. In the former method the mean flux and the mean magnetizing force over the cross section of the ring were measured. The ring experimented on was of appreciable radial depth, so that the magnetic force on the inner circumference of the ring was about fifty per cent greater than that on the outer circumference. The permeability of the iron at the greater force would probably be very different from that at the smaller force. The mean value, therefore, of the flux density over the cross sectional area of the ring might possibly be something quite different from the value it would have if the magnetic force were constant and equal to the mean magnetic force. The errors due to this cause in the ring method, even when the ring was narrow, were sometimes very appreciable. The criticism also applied to many cases in which electricians apply what they call the fundamental magnetic equation.

Dr. Drysdale, in reply to Professor Thompson, said that the end effect was not of the same nature as an air-gap or it would have had a more marked influence at high permeabilities. When the instrument was first introduced, a few tests had been made by drilling a specimen and testing it, and afterward annealing and re-testing. No change had been observed, but possibly a greater number of tests would have shown variations. The size of the pin seemed not to vary by more than a mil whatever metal was drilled. As to Mr. Campbell's remarks, he quite agreed that other permeameters were equally or more accurate, but this was the only one that could be used on the actual forging or casting, and it was surprising and gratifying to find that it was as accurate as it seemed to be. The thickness of the ring mentioned by Mr. Russell was an important point. It was necessary in order to permit of drilling, but he was inclined to think that there would be little error from this cause except at low inductions.

Dr. Drysdale read a paper on "The Use of Shunts and Transformers with Alternate Current Measuring Instruments." Owing to the limited range of most alternate-current instruments shunts and transformers have come into considerable use, but they are liable to cause errors both in the magnitude and phase of the current. The paper dealt with these errors mathematically and experimentally. In the case of shunts, the condition for accuracy at all frequencies is that the time constants of the instrument and shunt should be equal.

but formulæ are given for the multiplying power and phase displacement in other cases. For current transformers the best results are obtained by keeping the magnetizing and core-loss currents as small as possible. The best uniformity of ratio for different loads is obtained with a non-inductive or leading load; but the lowest phase displacement with a lagging load. Potential transformers are much more satisfactory than current transformers, both for ratio and phase displacement. Experimental tests using a wattmeter as indicator approximately confirmed the theory.

A. Russell suggested that the author should take the mutual inductance between the shunt and the instrument into account. If L_1, R_1 be the constants of the instrument and L_2, R_2, those of the shunt, and if M be the mutual inductance between them, the multiplying factor for the reading will be the same whatever the frequency provided that $\frac{L_1 - M}{R_1} = \frac{L_2 - M}{R_2}$.

Kenelm Edgecumbe referred to the fact that the author recommended small core-losses, and pointed out that he had seen it stated that in special cases it was possible to improve the ratio and phase errors by increasing the core-losses.

Dr. Drysdale said the air-core transformer is good, but in practice instrument-makers were forced to use iron for commercial reasons. Similarly, the ring form of transformer was generally impossible, as in practice instrument transformers were used to insulate the observing instrument from high-pressure mains, and considerable insulation between the windings was necessary. The reason why an iron-cored transformer behaved differently from one with an air core chiefly resided in the core-loss current, which was not proportional to the magnetizing current.

A paper on "Dynamometer Wattmeters" was read by Dr. Drysdale. The author gives a somewhat complete investigation of the theory of the wattmeter, including the effects of shunt inductance and capacity, mutual inductance, eddy currents, wave-form and of iron. It is pointed out that the theory of the wattmeter is much obscured by the use of the correction factor. On sine wave forms the true power $\omega = W \cos \Phi$, while the reading of the wattmeter

$$\omega' = \frac{R}{I} W \cos(\phi - a) = W \cos a \cos(\phi - a),$$

where W is the apparent power, R and I the resistance and inductance of the shunt respectively, and a the angle of lag in the shunt. This leads to the simple relation

$$\omega = \frac{\omega'}{1 + T^2 p^2} - Tp W \sin \phi,$$

where T is the time constant of the shunt and $p = 2\pi \times$ frequency. In practice T^2p^2 can be neglected in comparison with unity and hence $d\omega = \omega' - \omega = Tp W \sin \Phi$, which is perfectly determinate at all power factors. This shows that the correction of a wattmeter should always be applied as a difference and not as a ratio. It is practically as absurd to apply a correction factor to a wattmeter as to an instrument with a zero displacement. The paper also contains a description of some single and double forms of standard wattmeter and of deflectional wattmeters containing iron. Also of the method of testing wattmeters for various errors and of a phase-shifting transformer for facilitating these tests. Various forms of wattmeters and phase-shifters were shown in operation.

W. Duddell said, in some ways he thought a correction factor was preferable to the addition of a zero correction.

Mr. Rayner, referring to the accuracy of the instruments, asked if Hooke's law held to one part in 500 over a whole turn of the torsion head.

Mr. Tinsley remarked that the instrument shown resembled those of Mr. Duddell in the mechanical details because the design adopted was the only practical one.

Dr. Drysdale, in reply, said he still maintained that the only rational way of correcting wattmeter readings was by adding a correcting term instead of applying a correction factor. Mr. Beattie's device was unnecessary and of little use, as the inductive coil would not give any indication of the error due to capacity in the shunt, which might be considerable. He had not troubled about astaticism in his instruments, as they were for use as standards, and it was easy to eliminate the effect of stray fields.

The New Subways for New York City.

John B. McDonald, the builder of the Interborough subway, at the request of Herman A. Metz, controller of the city of New York, has made a report on the possibilities of the proposed new subways in Manhattan and the borough of Brooklyn. He believes that unless the plans for the Broadway-Lexington avenue subway in Manhattan, and the Fourth avenue subway in Brooklyn, are modified, their cost will be so great that the lines will not be able to carry enough passengers under any conditions to meet their fixed charges, and will become a heavy burden to the city. Mr. McDonald believes that in order to complete east and west side lines, extensions to the present subway should be made. For the east side, extensions should be made from Forty-second street to Pelham Bay Park, and for the west side, extensions should be made from Broadway and Forty-fifth street south through Seventh avenue to Battery Park. Immediate relief would be provided the people of the east side and The Bronx by adding for express service two tracks on the Second avenue elevated road, and by the extension of the west side elevated lines *via* Jerome avenue. If the Fourth avenue subway in Brooklyn must be built, Mr. McDonald suggests that in order that it may meet charges it be constructed as a two-track road, and not as a four-track road, as planned. If the territory develops, two more tracks can be added.

Chicago Telephone Business.

The report of the Chicago Telephone Company for April shows gains in subscribers, gains in revenue, and heavy expenditures for improvements. The report shows that 2,346 telephones were gained during the month. It is also stated that the company has in the neighborhood of 7,000 orders for new telephones ahead, and that the contracts keep increasing, despite the utmost efforts on the part of the management to push the work of installing instruments at a greater rate than orders for them are received.

From December 1 to April 1 the company expended $1,185,000 for changes in service and improvements required under the new ordinance, and will spend $2,000,000 more before the present year is at an end. These funds are taken out of the money provided by the recent sale of additional stock at par, and the improvements should steadily add to the company's income.

The growth of the service since January 1 shows a much higher average in the city than a year ago, while the additional telephones installed on toll lines show considerable decline by similar comparison. The April increase in telephones this year amounted to 2,075 in the city, and 271 in the country. The monthly increases, compared with the previous year, with the totals for four months, are given below:

	1907.		1906	
	City.	Country.	City.	Country.
January	2,830	245	2,213	801
February	2,131	236	1,956	740
March	3,276	288	1,980	740
April	2,075	271	2,222	1,006
Totals	10,312	1,040	8,371	3,287
	....	10,312	....	8,371
Inc. since Jan. 1	....	11,352	....	11,658

Illuminating Engineering Society.

A meeting of the New York section of the Illuminating Engineering Society was held at the Engineering Societies Building, New York city, on the evening of Thursday, May 14. Dr. Clayton H. Sharp, formerly president of the society, opened the meeting, and called upon the secretary of the section for a report. Secretary Millar said that seven new members of the section had been elected, and for the information of those present he stated that the invitation extended by the Philadelphia section to the society to hold the annual convention during Old Home Week in Philadelphia had been accepted. The convention will be held in that city on October 6 and 7.

In introducing Dr. E. L. Nichols, who was to present the paper of the evening, Dr. Sharp said that since Dr. Nichols had just returned from Washington, where he had attended a meeting of the conference of governors which was held to consider the conservation of the resources of the country, he would ask him if he would not give a brief account of what had taken place during his presence, as the matter was one of vital importance to the entire country.

Dr. Nichols, complying with the request, sketched briefly the events of the meeting at which he had been present, but as a fuller account of this conference is given elsewhere in this issue there is no need to relate them here.

Dr. Nichols then took up the subject of his paper, which was entitled "Daylight and Artificial Light." The object of this paper was to find, if possible, some logical means of comparing daylight and artificial light.

It is frequently urged, as an advantage of new forms of illuminants, that the light which they give is like daylight. Such statements, even when based on slight foundation, indicate a general belief in the superiority of daylight to artificial light. Daylight is derived exclusively from the sun, which may be regarded as an incandescent source having a temperature of about 6,000 degrees centigrade, and which sends to us light of an essentially continuous spectrum. This light, however, is greatly modified by atmospheric absorption. A varying portion comes to us after selective reflection from minute particles in a turbid atmosphere, from the cloud masses and from the surface of the earth itself. The extent to which sunlight is affected in this way was shown by a number of tables and curves illustrating the varying ratios between the rays of light of different wave length. The violet end of the spectrum is reduced to about one-half in passing through the atmosphere, while the red end loses less than twenty-five per cent of its initial intensity. The ultra-violet is affected even more than the violet. Of the indirect components of daylight, that from the unclouded sky is relatively stronger in the blue and violet than sunlight, by greatly varying amounts which depend upon the state of the atmosphere. An ideal relation for skylight and sunlight was deduced by Lord Rayleigh from the properties of a turbid medium, but actual skylight rarely approaches this ideal. The curves obtained from measurements are much nearer to those of sunlight, nor is it found that skylight at elevated stations approaches more nearly to the ideal, for measurements made at elevated points have shown less divergence from direct sunlight than corresponding measurements made at lower stations.

Unshaded surfaces receive sunlight and skylight in varying proportions. In bright weather the ratio of shaded to sunlit illumination is approximately fifteen per cent. At great altitudes the ratio would probably be even greater. If by daylight is meant the illumination of an unshaded surface, this will then differ from sunlight but slightly in quality, since the sunlight is the dominant factor. If, however, daylight be defined as the light illuminating a shaded surface, this will always be bluer than sunlight, occasionally with the violet relatively eight or ten times as strong as the red, and ranging from this to light less than twice as blue as sunlight.

As is well known, the maximum of the luminous intensity curve for the normal human eye is in the same region of the spectrum as the maximum energy curve of sunlight, but this may be regarded as a result of evolution and not as a coincidence. Hence it may be taken as a general principle that the normal stimulus of the eye is diffused daylight, since man was not originally nocturnal in his habits, and, therefore, those artificial stimuli which depart widely from it, either as to intensity or quality, are sure to be unsatisfactory and are likely to be injurious.

Dr. Nichols then gave records of investigations made to determine the range of intensity of ordinary daylight as between summer and winter, or between noontime in the open air on a fine day when the sky is filled with sunlit cloud masses and a dark, overcast day. Weber and Basquin have given curves showing the gradual increase in intensity of daylight from the winter to the summer months reaching a maximum about June and July. It then falls off again as the season advances. While the curves are somewhat irregular, they indicate that daylight in July is about ten times as bright as in December.

Basquin has also given results showing the variation of intensity during the day. The maximum is reached about, or a little after, noon, while in the afternoon the intensity is considerably greater than for corresponding hours of the forenoon. That is to say, at four in the afternoon the intensity was about forty per cent greater than at eight in the morning. This is due, doubtless, to the formation of mist and clouds during the day, which reflect light from above and add to the intensity of the illumination below. It is indeed a notable fact that daylight on a partly cloudy day is more intense than on a perfectly clear day. Indeed, the illumination, when the sky is entirely overcast with clouds, is practically as intense as with a perfectly clear sky.

The eye is capable of accommodating itself to these wide variations in illumination and indeed may accustom itself, after a time, to unusual conditions such as reflections from snow and water, but in high altitudes this is not the case, since the ultra-violet rays are present there in greater proportion and are injurious. For such conditions dark glasses should be used to protect the eyes. This fact shows that the absorption of the ultra-violet rays by the atmosphere is only just sufficient at lower levels to protect the eye, and we are near the danger limit in this respect.

Spectrophotometric study of daylight shows an exceedingly variable composition, so that it is very difficult to determine a standard. Dr. Nichols overcomes this difficulty by averaging a large number of observations made by various investigators at various stations. From these he deduces three curves: One, the average for stations in high altitudes; the second, the average for stations in low altitudes, and the third, the average for all stations. These curves show that the intensity of the light is considerably greater in the short wave-lengths for the elevated stations than for the low ones, but the curves have in general the same form. To use these curves as standards of comparision, the usual practice of constructing a curve of ratios, taking the

intensity of the yellow at wave-length 0.59 micron is followed, and when this is done the curves giving the ratios of the intensities of the different wave-lengths of various artificial lights, which are constructed, show that it makes little difference which of the standard curves is used.

When this is done artificial illuminants fall into three classes. Class one contains the older sources of light, which owe their luminous intensity to incandescent carbon; this includes flame lamps and incandescent electric lamps. As regards the quality of light emitted by this class, the Hefner and the acetylene flame may be regarded as the extremes between which other sources ordinarily employed take intermediate places. Candles, oil and gas flames are very nearly identical with the Hefner lamp, and the incandescent electric lamp of twenty years ago, as used on commercial circuits, was scarcely to be distinguished in its color from these. Improvements in the conditions of combustion have gradually raised the temperature of such of those sources of light employing flame as have continued to be employed in modern illumination, bringing them nearer to the acetylene flame. Comparing the curve for the Hefner lamp with those obtained from the average values for daylight in high and low altitudes, two curves of ratios are thus deduced which lie very close together, showing practically no difference. The curve comparing acetylene with sky brings out the greater ratio of intensity of the short wave-lengths and the lower ratio of intensity of the long wave-lengths of this light with reference to the light from the Hefner lamp. Curves showing the ratios for light from an oil lamp to daylight and gaslight to daylight show but slight difference, the gas being a little whiter—that is to say, it has a greater proportion of the light in the short wave-lengths and a smaller proportion in the longer.

For convenience, the acetylene flame may be taken as a practical standard of comparison after the relation of its light to daylight is established. Using this, Dr. Nichols has prepared curves showing the distribution of intensity for the carbon filament, the tantalum, the tungsten and the Nernst lamps at the voltages specified for each. These curves show that the important characteristic of the newer high-efficiency lamps consists in the relative weakness in the red rays (and hence slightly increased intensities in the green and yellow), but no preponderance in the blue and violet, as compared with acetylene. The tantalum and Nernst filaments and the so-called metallized-carbon filament, when of the same brightness in the yellow, are much weaker in the violet than the acetylene flame. The spectra of these newer incandescent lamps lie closer in quality of composition to acetylene than to the Hefner standard. Their differences in color are by no means so marked as is frequently assumed. They all fall properly into class one. This change in the distribution of intensities in the spectra of these sources, as compared with the radiation from carbon, is such as to make for increased efficiency when measured in candle-power per watt, because in the red end of the spectrum it is that the flow of energy is great and the luminosity here is small. The curves for these sources indicate that the type of radiation is closely related to that which is received from the sun, differing from the latter primarily on account of the lower temperatures. The practical identity as to quality of flame sources seems to indicate that the temperature attained by carbon ordinarily tends to a constant value, which can be exceeded only by profoundly modifying the conditions of combustion. In the same way, considering the necessity of stability and long life, it may be said that the temperatures at which it is possible to maintain carbon, whether treated or untreated, and the various forms of metallic filaments are not so very different in the various cases, and the existing variations in efficiency are due, in part at least, to departure from the ordinary black-body radiation in which the more luminous rays in the middle of the spectrum are relatively stronger than the red or violet.

The second class of illuminants, as divided by Dr. Nichols, includes those in which the source of light consists of incandescent oxids. These show selective radiation. To this class belong the lime light, the zircon light, the Welsbach mantle and the flame of burning magnesium. The Nernst glower, by definition, falls into this group, although when used under ordinary commercial conditions it has little to distinguish it from the ordinary carbon sources. It is possible to make glowers which furnish a different type of light, but these have not yet sufficient stability. Curves for these lamps show that the zircon light is a trifle whiter than acetylene. The lime light has fallen into disuse, the only fact worth noting regarding it being that it is whiter than acetylene when freshly ignited lime is used, but after ten minutes the whiteness diminishes until it is less than that of the acetylene.

The Welsbach mantles show considerable variation, certain of them giving pronounced selective radiation in the yellow. These curves show a noteworthy change in the distribution of intensities throughout the spectrum with age, a peculiarity which has been verified by life tests of such mantles by Dr. Nichols.

The flame of burning magnesium is the most remarkable example which has yet been subjected to measurement of selective radiation. This source of light is of importance mainly in photographic work. This light may be considered as due to two independent causes: incandescence at high temperatures, and intense luminescence of a type giving a band with a maximum somewhere in the ultra-violet. When the spectrum of the magnesium flame is equal to that of daylight in the yellow it increases relatively toward the red by reason of its lower temperature of incandescence, and also toward the violet because of its luminescence. It is the latter fact which gives it its actinic quality.

In the third class Dr. Nichols places artificial light sources, the spectra of which consist of a few, or many, bright lines. There is no simple and direct way of comparing the various flaming arcs, the mercury arc or the vacuum tube light, quantitatively with daylight. When the number of lines is great and well distributed the spectrophotometer might be used, but in the mercury arc nearly all the light comes from three narrow regions, in the yellow, green and violet, the latter of which is the brightest. Assuming equal intensities for the yellow of the mercury arc and acetylene, the green light is 3.75 times as intense as that of the acetylene, and three times as intense as that of daylight. The violet line is nearly seventeen times as intense as the corresponding wave-length in the acetylene, and 7.85 times that of daylight. Attempting to define the quality of the light of the mercury arc by means of its effect in producing the three primary color sensations using the color curves of the normal eye, the ratios are: red, 8.4; green, 30; violet, 50.7; whereas, ordinary daylight produces these sensations in equal intensity.

The light of the ordinary carbon arc lamp partakes of the nature of the first and third of the three classes. It has groups of bright lines superimposed upon a continuous spectrum. When the carbons are unimpregnated, the only lines

strong enough to affect appreciably the quality of the light are those of the band at wave-length 0.425 micron. The intensity of this band fluctuates greatly, the value given being a fair average. As compared with our standard daylight, this is 3.5 times as intense. Its relative brightness is somewhat less than twice that of the corresponding region in the spectrum of the magnesium flame and somewhat less than half that of the violet line in the mercury arc.

Dr. Nichols concludes that of the sources studied, no one approaches identity with daylight as to composition, although the relation of class one to daylight is a simple one, easily expressed in graphic form.

Professor William Hallock, in opening the discussion, emphasized the need for research in the field which Dr. Nichols had opened, and which, up to the presentation of this paper, has been practically unexplored. He complimented the society and Dr. Nichols on the valuable information which he had now, for the first time, made available to illuminating engineers. Respecting the claims made frequently on the superior quality of new forms of illuminants, he said that when compared with daylight there was not much difference in the qualities of the different artificial lights, but all of them differed so greatly from daylight that it was not worth while to make this comparison. Increase in efficiency due to increase in temperature seemed less likely to yield results than researches in another line, and he called attention to the work of Langley on the luminous efficiency of the firefly. It may be a coincidence, but, more likely, is a result of evolution, that the luminous band of light emitted by the firefly lies in that part of the spectrum to which the human eye is most sensitive. This seems to indicate that the eyes of other animals are probably adapted to nearly the same spectral range, but there is a possibility that since certain animals have developed a highly efficient producer of light, they may also have developed eyes more sensitive to certain radiations than the human eye.

Dr. A. H. Elliott rejoiced to have available the results of Dr. Nichols's investigations. He said that these might also have some bearing on the methods of color photography. Referring to Dr. Nichols' suggested method of comparing the various forms of arc lamp with daylight, he said that a somewhat similar plan had been proposed by Dr. C. P. Steinmetz in the recent address before the American Institute of Electrical Engineers, in which it was suggested that the three luminous bands of the mercury-vapor lamp might be taken as a basis for the construction of a light of standard quality, the three colors to be mixed in certain proportions.

J. W. Howell said one immediate good effect of Dr. Nichols' paper would be the reply it contained to loose statements which had been made too frequently of late about the injurious effect upon the human eye of the new illuminants. The difference in quality of these artificial lights, as compared with daylight, is to be attributed to the difference in temperature of the artificial source, which is about 2,000 degrees centigrade, and that of the sun, which is about 6,000.

J. W. Lieb, Jr., expressed his appreciation of the high scientific, as well as practical, value of the researches which had been made by Dr. Nichols.

J. W. Woodwell attached particular value to the paper because it directs attention to the quality of the light, rather than to the intensity of illumination. Up to the present time the latter has been the chief consideration, but we have now reached a stage where we can control efficiently the distribution of light, and we have a large variety of sources to choose from. For this reason increased stress may be laid upon the selection of an illuminant giving the desired quality of light.

Replying to questions by P. S. Millar and others, Dr. Nichols said, although, as compared with sunlight, the lights from the artificial sources differ but slightly one from the other, these slight differences become important when colored objects are viewed, and even though any particular part of the spectrum may be present in quantity too slight to have any appreciable effect upon the candlepower of the source, which is determined mainly by the yellow component, the absence of any color of light affects colored objects most noticeably. There is another effect which must be urged, and that is the increased intensity of illumination required when the light is very diffused. The eye is content with a much lower intensity of illumination where contrasts are present than where the illumination is uniform. As regards the suggestion that some other means than simply increasing the temperature of a body should be sought in order to obtain more efficient sources of light, he said there is one difficulty. Light coming from luminescence sources consists usually of fairly narrow bands in the spectrum. That from the firefly, for example, is but a narrow band in the greenish-yellow, and while such a source would be very efficient as a producer of light, it would give light of a very poor quality. Such a method would only be satisfactory if it produced efficiently bands lying in different parts of the spectrum.

The meeting was then adjourned.

National Conference on the Conservation of Natural Resources.

What was probably the most important convention of federal and state authorities and representatives of engineering and industrial organizations was held at the White House, Washington, D. C., May 13 to May 15, at the request of President Roosevelt. Governors of all the states in the Union, together with their conferees, members of the Cabinet, the army and navy, presidents and secretaries and representatives of the national engineering organizations, and representative financial and industrial men attended this conference.

The convention was held in the East Room of the White House, and the proceedings were formally opened by President Roosevelt on May 13 at 11 A. M. In his opening address President Roosevelt called attention to the increase of knowledge concerning the resources of the United States and the growth of the nation. The rapid development has brought with it the rapid destruction of our natural resources. Our position in the world has been attained by the extent and thoroughness of the control which has been achieved over Nature, but we are more, and not less, dependent upon what she furnishes than at any previous time of history since the days of primitive man. The enormous stores of mineral oil and gas are largely gone. Our natural waterways are not gone, but they have been so injured by neglect and by the division of responsibility and lack of system in dealing with them that there is less navigation on them now than there was fifty years ago. Finally, we began with soils of unexampled fertility, and we have so impoverished them by injudicious use and by failing to check erosion that their crop-producing power is diminishing instead of increasing. In a word, we have thoughtlessly and to a large degree unnecessarily diminished the resources upon which not only our prosperity but the prosperity of our children must always depend. We are coming to recognize as never before the right of the nation to guard its own future in the essential matter of natural resources.

At the Wednesday afternoon session Andrew Carnegie read a paper on "The Conservation of Ores and Related Minerals." Mr. Carnegie said that coal consumption is increasing at an astonishing rate. During the period for which statistics have been gathered it has doubled, and during each decade of late it has

more than doubled. In 1907 the production was about 450,000,000 tons. At this rate of increase the production in 1917 will be 900,000,000, and in 1927, 1,800,000,000 tons, and in 1937, over 3,500,000,000 tons. All estimates of future consumption and destruction of coal are liable to error, yet, making all reasonable allowance, unless there be careful husbanding or revolutionizing inventions or some industrial revolution, the greater part of the estimated quantity of coal forming our original heritage will be gone at the end of the next century, say, 200 years hence.

Our methods of consuming coal are more wasteful than our processes of mining. Of all the coal burned in the power plants of the country not more than five per cent to ten per cent of the potential energy is actually used. The remaining ninety to ninety-five per cent is absorbed in rendering the smaller fraction available in actual work.

Mr. Carnegie was followed by Dr. I. C. White, on "The State of Our Fuel Resources."

The second day's session was opened on Thursday morning, May 14, at 11 o'clock. Governor John A. Johnson, of Minnesota, presided.

James S. Whipple, forest commissioner of the state of New York, addressed the convention and described the work of the state in reforestation.

The address of the morning was read by James J. Hill, president of the Great Northern Railway. This was on "The Natural Wealth of the Land and Its Conservation." Mr. Hill's address was received with great enthusiasm, and forms one of the most important features of the conference. According to Mr. Hill, the people of America are the most sinful wasters of man's inheritance on earth. The sum of resources is simple and fixed. From the sea, the mine, the forest and the soil must be gathered everything that can sustain the life of man. Upon the wealth that these supply must be conditioned forever, as far as we can see, not only his progress but his continued existence on earth. Mr. Hill called attention to the rapid exhaustion of our forests and coal supplies, and stated also that the iron industry tells the same story. Of the land capable of producing material agricultural resources only 86,500,000 acres were left. Equally serious was the change in the quality of productiveness of the land. The loss of fertile soil caused by erosion and the deterioration caused by unscientific farming were also cutting down the possibilities of reproduction. We might expand our resources and add billions of dollars to our natural wealth by conserving soil resources instead of exhausting them as we have the forests and the contents of the mines.

A paper was read by Professor T. C. Chamberlain on "Soil Wastage," followed by a paper on "Forest Conservation," by R. A. Long. These papers were followed by a general discussion led by Secretary of Agriculture Wilson.

The afternoon session was opened by President Roosevelt at 2.40 o'clock. The first speaker was ex-Governor Pardee, of California, who read a paper on "Resources Related to Irrigation." A paper on "Grazing and Stock Raising" was read by H. A. Jastro, president of the American Live Stock Association.

The closing session was held on the morning of May 15. The technical papers scheduled for this session, including that by H. S. Putnam, of the American Institute of Electrical Engineers, entitled "Water Power," were not presented, but will appear in the record. The session was devoted principally to a general discussion of a declaration of principles. The wise forethought of the President in sounding the note of warning as to the waste and exhaustion of natural resources was commended, and his action in calling the conference to consider the matter was thought to be worthy of high appreciation. It was agreed that co-operation should find expression in suitable action by Congress within the limits of and coextensive with the national jurisdiction of the subject, and complementary thereto by the legislatures of the several states within the limits of and coextensive with their jurisdiction. It was agreed that it would be wise to hold further conferences between the President, members of Congress and the governors of the states on the conservation of natural resources, with a view to continued co-operation and action on the lines suggested. To this end it was advisable that from time to time, as in his judgment might be wise, the President should call the governors of the states, members of Congress and others into conference.

It was recommended that each state appoint a commission on the conservation of natural resources, to co-operate with each other and with any similar commission on behalf of the Federal Government. The enactment of laws looking to the prevention of waste in the mining and extraction of coal, oil, gas and minerals, with a view to their wise conservation for the use of the people, and to the protection of human life in the mines, was recommended.

Concerning water powers, the following declaration was accepted as part of the resolution:

We recognize in our waters a most valuable asset of the people of the United States and we recommend the enactment of laws looking to the conservation of water resources for irrigation, water supply, power and navigation, to the end that navigable and source streams may be brought under complete control and fully utilized for every purpose. We especially urge on the Federal Congress the immediate adoption of a wise, active and thorough waterway policy, providing for the prompt improvement of our streams and conservation of their watersheds required for the uses of commerce and the protection of the interests of our people.

After the formal adjournment an informal meeting of the governors was held, and it was arranged to appoint a committee of five to consider the matter of further conferences. It was resolved that another conference ought to be held in 1909.

Lecture Before the New York Electrical Trades School.

Professor Charles P. Steinmetz delivered a lecture under the auspices of the New York Electrical Trades School, in the auditorium of the Engineering Societies Building, New York city, Sunday afternoon, May 17. The topic taken was the "Conservation of our Natural Resources." Dr. Steinmetz emphasized the rapidity with which we are exhausting our supplies of coal and the importance of properly developing and protecting our water powers, as these in the future will become our main dependence, not only for power and light, but for heat as well. No doubt in the same way the necessary fertilizer for the soil will be provided, as the natural stores of fertilizers have been nearly exhausted. Dr. Steinmetz, while extolling what had been done by electrical methods, said that as yet we have only begun this great work. The accomplishments in the future will far surpass those in the past.

Chair of Chemistry.

Director William S. Aldrich, of the Thomas S. Clarkson Memorial School of Technology, Potsdam, New York, announces that the chair of chemistry in this institution is to be filled at the annual meeting of the board of trustees, June 10, 1908. Detailed information may be obtained by writing to the director.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

The Radioactivity of Ordinary Metals.

An investigation into the radioactivity of ordinary metals has been made by J. C. McLennan, who has studied the effect of lead, zinc and aluminum, when made up in the form of cylinders sixty centimetres long and twenty-four centimetres in diameter, upon the conductivity of the confined air. It is found that the effect varied widely, ranging apparently for lead from 160 to twenty-three ions per cubic centimetre per second. For aluminum and zinc the value seemed to be about fifteen. An endeavor to obtain more satisfactory results was made by C. S. Wright, whose results are mentioned here by Mr. McLennan. The former's experiments gave results varying from 2.5 to 15.3 ions per cubic centimetre for the three metals, the variations being slight. The method was then extended to determine the effect of various soils and rocks upon air enclosed in these cylinders. Experiments were also made above the water of Lake Ontario, where it was found that the conductivity of the air was much lower than on land. These experiments gave values varying from six to 8.6 ions per cubic centimetre per second. When the cylinder was lowered beneath the surface of the water, the value was still further reduced, falling to 2.5 at a depth of sixty feet. From the constants of the results it seemed likely that the water of the lead completely screens off radiation from the rock or soil beneath it. To check this, various experiments were made on the absorbing power of water for the gamma rays of radium. A tube containing radium was lowered to various depths beneath the surface of the lake, which at that time was covered with ice. When beneath the test chamber in air, the conductivity corresponded to about 4,500 ions per cubic centimetre; when a foot and a half below, this was reduced to one-tenth its former value; at one metre it had fallen to sixteen; at two metres, to 0.69, and at three metres, to 0.62. From the extremely low values of conductivity found for cylinders of the three metals mentioned, the author concludes that if it were possible to obtain these metals in very pure condition and to avoid external influences, that the conductivity due to them would fall to a very low value, if it did not entirely vanish.—*Abstracted from Nature (London), April 30.*

Some Notes on High-Tension Insulators for Overhead Transmission Lines.

Continuing his article on high-tension insulators, C. J. Greene describes some tests which he has conducted on various types of insulator, many European and American makes being represented, intended for service voltages of from 2,000 to 60,000. One interesting feature was noticed while testing some of the high-voltage insulators after they had been coated with a mixture of coal dust and water, intended to represent conditions of insulators working near railways. When a testing voltage of 50,000 was reached, these insulators began to clean themselves by repelling the dirt, while the water was evaporated. It is thought that this self-cleaning action may be of considerable importance for very high-voltage lines. After studying the puncture voltage of different insulators, the author comes to the conclusion that it is a mistake to make any single part of an insulator with a greater thickness than one inch, because of the difficulty of cooling uniformly such thick masses of porcelain. For this reason large insulators should be built up of sections cemented together. The fact that the position of a breakdown can not be foretold points to the absolute necessity of submitting every insulator to a pressure test. The average puncture voltage of porcelain is found to be approximately 100,000 volts per inch. The author discusses the effect of rain, and estimates how much the sparking distance is shortened when rain drives against the insulator at an angle of forty-five degrees. He presents a large number of results of tests which give the dimensions of the insulators, the arcing distance, both dry and wet; the distances at which the insulator arced, both dry and wet; the creeping surface, and various ratios deduced from these factors. It is found that in certain types of insulators—those which are short and squat—the arcing distance, when wet, is but little less than that when dry. This seems to follow in the use of a goodly number of petticoats. It was found that the German and Swedish insulators, proposed as standards, are smaller and have a smaller factor of safety than the Italian or French ones. It is thought that this may possibly have resulted from the drier climates of the former two countries. The author points out the undesirable feature of earthing the insulator pin, as the safety of the insulator is thereby materially reduced.—*Abstracted from the Electrical Review (London), April 24.*

An Emergency Street-Railway Brake.

An emergency brake for street-railway cars has been devised by J. P. Pringle, manager of the electric street railway system of Burton-on-Trent, England. The inventor of the new device takes the stand that a purely emergency brake should be provided, powerful enough to bring up sharply any car on any grade. For this purpose he places brake-shoes just in front of one pair of wheels. This shoe is suspended on a link and held up against the pressure of a spring by means of a wire cable controlled from the platforms of the car. To bring it into action, a lever releases the wire, allowing the spring to force the brake down against the rail, where the shoe fits into the groove of the rail, pressing against the sides, but not upon the bottom. This action brings it immediately in front of the wheels, which ride up on the brake, thus bringing the weight of the car upon the shoes and forcing the latter firmly into the grooves of the rails. With this arrangement, although only half of a four-wheel car is brought to bear upon the brake-shoes, due to the inclination of the rail groove the effective braking pressure is several times that weight. The effectiveness of this kind of emergency brake has been demonstrated in public tests. One conducted the latter part of last month, during a bad snowstorm, showed that when running at a speed of four and one-quarter miles an hour the car was stopped in four feet; at ten and one-half miles an hour, in twenty-three and one-half feet; at eighteen and one-quarter miles an hour, in 127.5 feet. When the rails were dry

the stops were somewhat shorter. It was found that the shock of stopping was considerably greater for low speeds than high, as in the latter case the wheels mounted higher upon the shoes, the momentum of the car being partially absorbed in this way. With this type of brake it is necessary, of course, to provide one pair for each direction of motion, but the brake lever enables either pair of these to be brought into action so as to hold the car in case of accident when either ascending or descending a grade. This brake is put forward by the inventor as a purely emergency brake to be used only to prevent accidents, and not for the normal service. It is simple in action and adds but little to the equipment. When used, the car must be backed off the shoes before they can be lifted from the rail. Various materials have been tried for making the shoes, that giving the most satisfactory results being manganese steel.—*Abstracted from Electrical Engineering (London), April* 30.

Knudsen's System of Wireless Transmission of Photographs.

A description is given here of the system of wireless transmission of photographs which has been devised by H. Knudsen, but which is yet in the early stages of development. The transmitter consists of a traveling carriage operated by clockwork, carrying a light stylus back and forth. This stylus travels over the surface of the picture to be transmitted, so that every part of the latter is traversed once during the complete operation. Mechanical action alone is relied on for giving the radiotelegraphic impulses, the stylus being normally at such a height that a gap exists in the relay circuit controlling the current of the primary coil. When the stylus is pushed up, contact is made, completing this relay circuit. In order to operate the system it is, therefore, necessary so to prepare the picture that those parts which are dark are in relief as compared with the parts that are light, or *vice versa*. This is effected by dusting the usual photographic negative with a powder which adheres to the dense parts of the negative, but not appreciably to the transparent parts. The sensitive plate on which the photograph is taken is made with a much thicker film of gelatine than usual. After development and before it is quite dry, it is dusted, when the powder adheres to the thicker parts, which are still moist, and not to the thinner, which have dried out. The dense parts of the film thus become raised, and consequently when the stylus traverses such parts, waves are transmitted to the receiving station. The receiver is a similar instrument, but in this the stylus is normally raised, being depressed only when a wave is received. This action is effected by a coherer and a relay circuit. The plate for receiving consists of a glass plate with blackened surface, such as lamp black. About fifteen minutes is required to transmit a four-by-five picture. Synchronism is maintained by stopping the carriage of the transmitter at the end of each backward stroke for a short time, a brake being applied to the clockwork. The carriage of the receiver stops automatically at the end of each stroke until started by an impulse sent by means of a second clockwork at the transmitting station, which at the same time starts the transmitter. Synchronism is thus effected at the beginning of every forward stroke. There is no device provided as yet for preventing interference from other wireless stations. The pictures are reproduced in flat colors, as there are no gradations between lights and shades, the stylus being always either up or down.—*Abstracted from the Electrician (London), May* 1.

Lighting System of the Orcutt, California, Oil Fields.

The large oil-sand lakes and subterranean gas works in the southern part of the Santa Maria valley, California, produce nearly 15,000,000 barrels of oil a year. The output of gas here is enormous, and at high pressure is from 100 to 400 pounds to the square inch. Some of the wells have an enormous outflow of oil at high pressure, and occasionally when this takes fire the derricks and the neighboring buildings are destroyed, causing great loss. For this reason an electric light system has been introduced for lighting the sixty wells now producing in this district. The cost of this plant, it is said, is less than that of four fires which occurred during but two years of the working of this district. An interesting feature of this installation is the simplicity of the method of distribution. Had the ordinary pole-line construction been adopted, it would have cost about $30,000. The method used is said to have saved about $9,000 of this. The country is hilly, and there are many trees which would have interfered considerably with an ordinary pole line. There is no snow in this district, although there are strong winds. The method adopted was a long-span distribution using copper cables and the oil-well derricks for supporting them. The lines are thus carried across country, saving considerably in the length of line and in vertical distance. Further, the long span work makes the installation in many sections easy and simple, and it is necessary to carry in hand only a small amount of material for expansion. Moreover, when one well is exhausted, it is inexpensive to move the line to another. The derricks are eighty feet high and are ideal supports for long spans. Where no derricks stood, steel frames have been made of scrap pipe set in cement. The system at present consists of nearly fourteen miles of cable carried on seventy derricks, nine steel pipe frames and ten frames of redwood. The average span is 800 feet, while there are two spans of 2,000 feet and more, and a great many 1,500 feet in length. The sags allowed are sixty feet for a 2,000-foot span. The cables are of stranded copper, equivalent to No. 4 and No. 6 Brown & Sharpe gauge. They are bare and spliced by means of copper sleeves. During high, and even gusty, storms the long spans are blown from twelve to twenty-five feet out of line, but the wires hang parallel and sway slowly. As fuel economy is of little importance, a low-voltage system of distribution was adopted. The lamps are for 210 to 250 volts, connected on a three-wire system. The maximum distance of transmission is two and one-half miles. The power plant contains two forty-five-kilowatt, 250-volt generators driven by steam engines.—*Abstracted from the Journal of Electricity, Power and Gas (San Francisco), May* 2.

Summer Courses in Engineering.

Columbia University, New York city, will offer, during the coming summer, the following courses counting toward the degrees of the Schools of Mines, Engineering and Chemistry and master of arts in the School of Pure Science. These courses, which are open, without examination, to all students who are qualified, begin July 7 and end August 14. They are: In civil engineering, hydraulics, structures, and reinforced concrete; in electrical engineering, electric train movement; in mechanical engineering, gas engines; in metallurgical engineering, metallography of iron, steel and industrial alloys. There are also courses in chemistry, drawing, forging, mathematics, mechanics, mineralogy, physics and shop work. Full information may be obtained by writing to the secretary of Columbia University, 116th street and Amsterdam avenue, New York city.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

A New Westinghouse Rotary Converter.

The direct-current voltage delivered by a rotary converter usually bears a fixed ratio to the alternating-current supply. In light and power work it is essential that the potential on the direct-current feeders be maintained constant without regard to the variations in the alternating-current voltage, and several methods have been devised for regulating the potential. Rotary converters are often compound wound, and this, when accompanied by a suitable reactance on the alternating-current side, has been the only automatic method of voltage regulation which did not entail considerable auxiliary wiring. Potential and induction regulators are used in many installations. Although these devices can be fitted up to control the voltage automatically, they not only occupy considerable space, but at the same time add a large amount to the auxiliary wiring required. The Westinghouse rotary converter with synchronous voltage regulator is designed to supply, in one compact, simple and efficient machine, an entirely self-contained piece of apparatus which would accomplish all that has heretofore been done by the use of the potential or induction regulator. These machines can be designed for either automatic or non-automatic control of the direct-current voltage. A number of Westinghouse rotary converters with synchronous voltage regulation are now in service on the lines of the New York Edison Company, where they have proved very successful. In designing these machines it was necessary to build them so that they could be installed in existing substations in the same space that had been occupied by rotary converters of an earlier design. This requirement was complied with.

The machines illustrated herewith are of 1,000-kilowatt, nominal capacity, and are designed to deliver direct current at 225 to 300 volts potential when receiving alternating current at 166 volts potential, six-phase, twenty-five cycles. These machines have sixteen poles and operate at 187.5 revolutions per minute. The rotary converter with synchronous regulator consists of a rotary converter of ordinary construction combined with a small alternating-current generator, the field and poles of the latter being supported by a bracket from the frame of the rotary converter field. The alternating-current regulating armature is carried on the same shaft with and between the armature of the rotary converter and the slip rings, and therefore requires no separate collector or brush-holder mechanism. The field coils are excited by current from the substation bus-bars. The direct-current voltage can be either raised or lowered by altering or reversing the field excitation of the alternating-current generator portion of the machine in a similar manner to that adopted in controlling the voltage of an alternating-current generator. The sole difference lies in the fact that the synchronous regulator is designed so that the normal direct-current voltage is delivered with normal voltage on the alternating-current side without any excitation of the regulator field. The direct-current voltage is increased or decreased by altering the strength or the polarity of the regulator field exciting current.

The advantage of this method of controlling the direct-current potential lies in the wide range of accurate control which can be secured without affecting the power-factor of the circuit and the compactness of the arrangement.

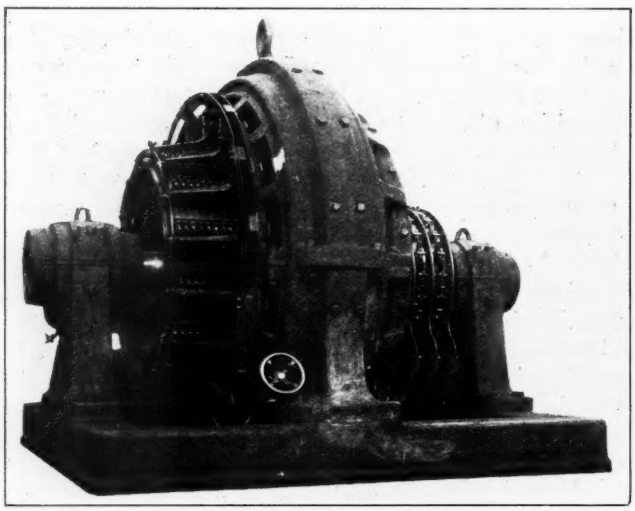


FIG. 1.—SIDE VIEW OF SIX-PHASE WESTINGHOUSE ROTARY CONVERTER FOR LIGHT AND POWER SERVICE.

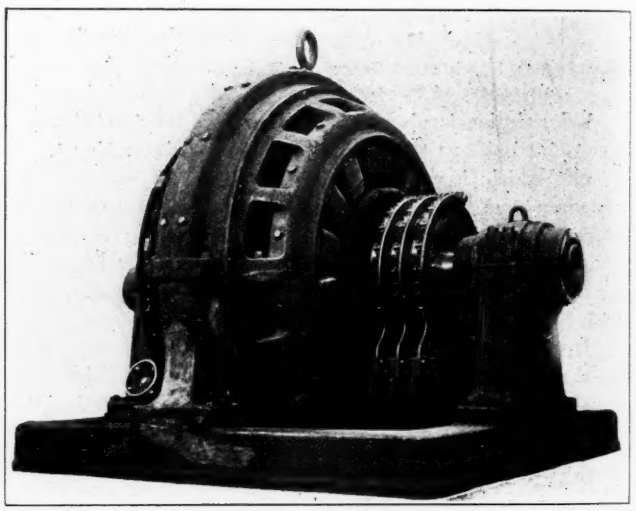


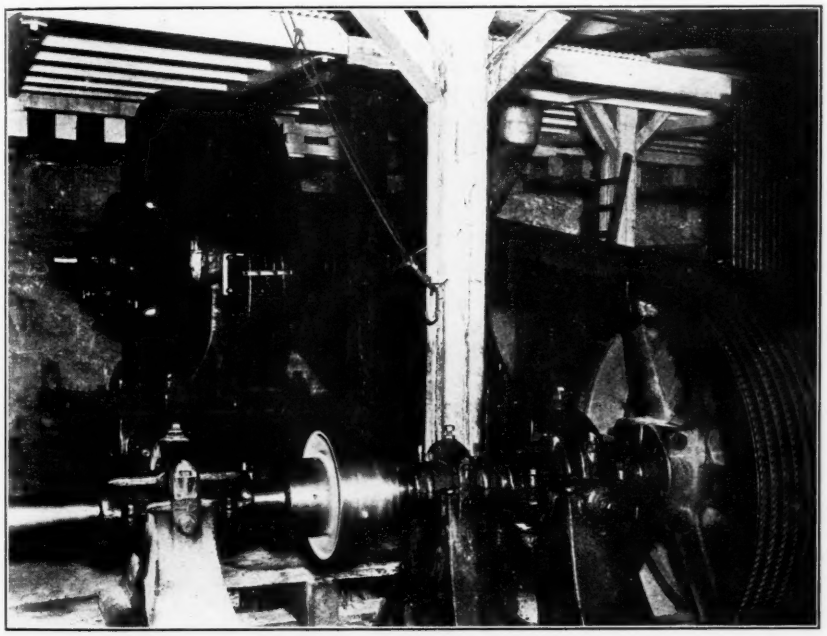
FIG. 2.—SIX-PHASE WESTINGHOUSE ROTARY CONVERTER, SHOWING SYNCHRONOUS REGULATOR AND ALTERNATING-CURRENT SIDE.

Civil Service Examinations for New York State and County Service.

The New York State Civil Service Commission will hold examinations on June 6 for the following positions; axeman, $2 a day; chief engineer, Erie County service, $4.50 a day; inspector of weights and measures, $1,100. The last day for filing applications for these examinations is May 30. Full information and application forms may be obtained from Charles S Fowler, chief examiner, Albany, N. Y.

Electric Motors in a Concentrating Plant.

The concentrating plant of the Anaconda Copper Company's famous Washoe smelter is one of the first in the country to be driven by electric power exclusively, four large induction motors being used for this purpose. The concentration building is 600 feet long, with the steam plant, heretofore used for driving it, located in the centre. The jigs, tables, etc., are driven from a main line-shaft 500 feet long, to which the engines have been connected by rope drive and friction clutch pulleys. It is intended to leave this steam plant intact, to be used as a reserve in case the electric power fails. The mill as a whole is divided into eight sections, four on each side of the engine room. Two



1,200-Horse-Power Induction Motor Installed at Concentrating Mill of Anaconda Copper Company.

induction motors are installed in each half of the mill, and connected to the main shaft by rope drive and friction clutch pulleys. Each motor has a 1,200-horse-power output at 360 revolutions per minute synchronous speed, and will furnish power sufficient to operate easily two mill sections. Connection is made to the main shaft by eighteen two-inch ropes, and the pulley dimensions are such that the main shaft is driven at 250 revolutions per minute.

These large motors are notable not only on account of their large capacity, but also because of their having squirrel-cage rotors, something unusual in motors of this size. Their guaranteed full-load efficiency is ninety-one per cent and full-load power-factor ninety-two per cent. Squirrel-cage motors were chosen for this installation because the conditions under which they have to start are favorable and also because of the higher power-factor of this kind of motor.

The general construction of these large induction motors is practically the same as that of the smaller ones built by the Allis-Chalmers Company. The stator punchings are supported in a substantial yoke to which the housings carrying the bearings are bolted. The stator is wound with copper strip, with the slot insulation formed around it under pressure in steam-heated molds. The rotor is mounted on a spider provided with cast-steel end rings, between which the laminations are held. The rotor slots are of the partially closed type, and the rotor bars are securely held in place by the overhanging tips of the teeth. The bars are bolted at each end to bronze rings, thus making a very strong rotor that can be safely run at high peripheral speed.

In addition to the four large motors there is also provided a 200-horse-power variable-speed, sixty-cycle, 2,080-volt induction motor for operating the pumps in the mill.

This motor is of standard type, with wound rotor and collector rings for the insertion of resistance in the secondary. The normal speed is 450 revolutions per minute, and can be reduced to 225 revolutions per minute by means of a grid-type resistance furnished with the motor.

The Allis-Chalmers Company has also furnished for this plant three synchronous motor-generator sets of 300 kilowatts output each, and one small induction motor-generator set for starting and exciting the synchronous sets. The 300-kilowatt sets are driven by twelve-pole, 2,080-volt, sixty-cycle synchronous motors and run at a speed of 600 revolutions per minute. The direct-current generators for these sets are compound wound for 550 volts and are easily able to carry fifty per cent overload for two hours without heating more than fifty-five degrees centigrade and without sparking. At normal full load the temperature rise does not exceed thirty-five degrees centigrade in any part.

The fields of the synchronous motors are excited from a 120-volt, twenty-five-kilowatt, direct-current generator driven by an induction motor. The same motor is also coupled to a small 500-volt direct-current machine. This machine has commutating poles, and a very large current can be taken from it for short intervals without sparking at the commutator or undue heating in any part of the machine.

Formerly all the power required by the Washoe smelter, which has been equipped throughout with electric drive, was obtained from steam engines, and a certain amount of steam power will probably always be used, as some of the steam boilers utilize the heat contained in the waste gases from the furnaces. However, this power, obtained as a by-product, is not nearly sufficient to operate the whole plant, and all additional power is now supplied by current transmitted from a hydroelectric plant on the Missouri River.

Mechanical Stoking a Success.

Just at the close of 1907, one of the largest orders ever placed for mechanical stoking equipment was received by the Westinghouse Machine Company, aggregating 14,400 boiler horse-power. This was for one of the large Brooklyn power stations operated by the Transit Development Company. This order comprises twenty-four stokers suited to 600-horse-power boilers of the Babcock & Wilcox water-tube type. Moreover, this is the second large order placed by this company for Roney stokers, and may be regarded as the direct result of a year's successful operation of the original 7,200-horse-power installation at the Kent avenue station. As this station was originally equipped with flat grates for hand firing, the merits of mechanical stoking have unquestionably been demonstrated along the lines of high economy and low operating cost.

The Westinghouse Electric Tailor's Goose.

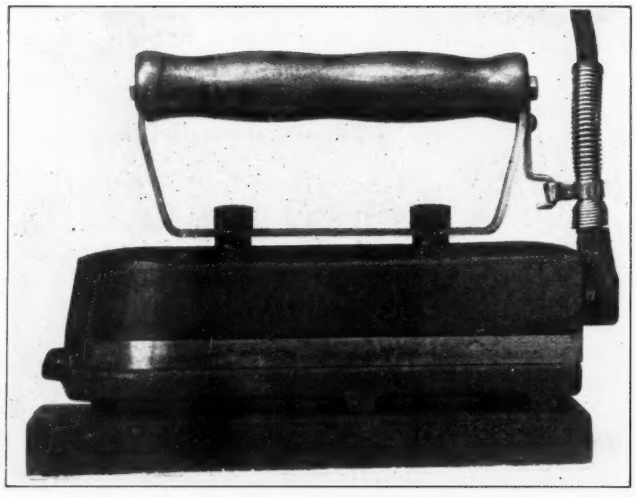
To meet the demand upon the part of manufacturing and custom tailors for an iron embodying the same principles as the Westinghouse electrically heated sad-iron, the Westinghouse Electric and Manufacturing Company has developed the goose shown in the illustrations.

This goose is designed to endure the same rough usage as the plain cast-iron goose and to fulfil all the requirements of the tailor with the elimination of the heat, dirt and inconveniences incident to other methods.

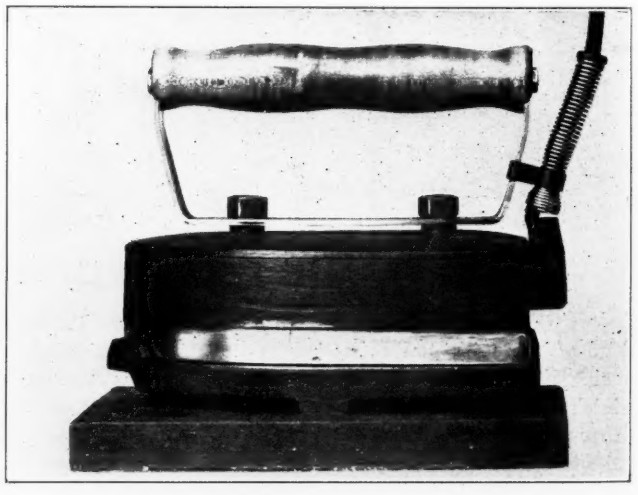
It is made in two shapes, wide and narrow. The wide goose is five and one-half inches by eight and one-half inches, and comes in four different weights: twelve, fifteen, eighteen and twenty-two pounds. The narrow goose is three inches by ten inches and is furnished in three different weights: twelve, fifteen and eighteen pounds. Both types are made for three different voltage ranges: 100-107, 108-115 and 116-125.

In order to avoid complication, a single heat alone is provided, which is sufficient to rapidly bring the iron to a working temperature and to maintain it uniformly during the heaviest service. On intermittent or light work the current can be turned off a considerable portion of the time, and the irons are constructed so that their working surface will remain hot a long time after the iron has been thoroughly heated.

The heating element is a thin steel grid, arranged to distribute the heat evenly over the entire working surface of the iron. This grid is hermetically sealed within a fireproof dielectric of good thermal conductivity, and is held between two solid iron blocks, the one of which forms the working surface of the iron, the other, immediately above it, serving as a heat reservoir or thermal equalizer by which the constant input of heat from the heating element is stored up and given out to suit the irregular demands of the work. These two portions of the iron are solidly secured together and in effect form a solid mass which is separated from the top of the iron by means of an air space which forms an effective heat insulator.



Wide Westinghouse Electrically Heated Tailor's Goose.



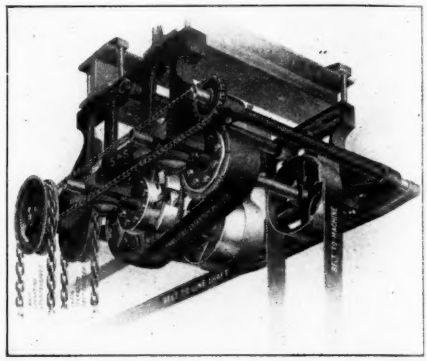
Narrow Westinghouse Electrically Heated Tailor's Goose.

The S. & S. Variable-Speed Countershaft.

The accompanying illustration shows an ingenious device which is being manufactured by the Rotary File and Machine Company, 589 Kent avenue, Brooklyn, N. Y.

Every manufacturer knows there is a leakage in profits through his inability to run his machines at just the limit speed suitable for the job on hand, but unlike a leaky joint in a steam pipe, it does not command attention by constantly reminding him of its existence. Few manufacturers have examined thoroughly from its financial standpoint and figured out accurately what this waste represents in dollars and cents. Large as the proportion may seem, the maker confidently assert that this wastage in many instances easily approximates twenty-five per cent of the yearly profit. The S. & S. variable-speed countershaft consists of an arrangement of expanding belt-operating pulleys, by means of which any variable-speed relation desired within the limits of 4 to 1 can be maintained at its maximum and capable of ready adjustment at a moment's notice.

The gear is made in fourteen standard sizes, capable of transmitting up to 128 horse-power. The variation in the diameter of the expansion pulley is effected in the following way: It will be noticed that the rim is divided into twelve sections, with two spokes riveted to each. These spokes slide in machined slots inside a cast-iron hub. Part of each spoke inside the boss has teeth milled on one edge and all are in mesh with a broad pinion. This pinion is operated by an inner shaft which is only capable of longitudinal movement, but owing to grooves being milled on the one end of this inner shaft, any movement given to same rotates the aforesaid pinion inside the hub, drawing the spokes in or forcing them out according to the direction of motion given to the hand-wheel, which operates both of these inner shafts simultaneously.



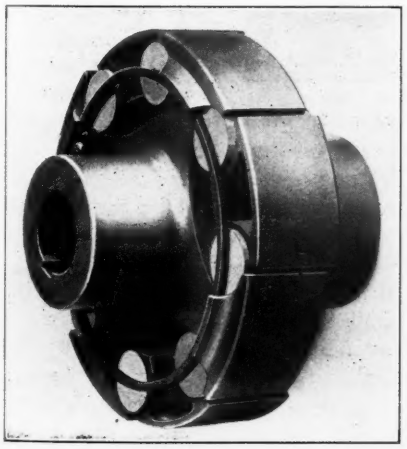
The S. & S. Variable-Speed Gear.

The following distinctive claims are made by the manufacturer: (1) Ability to transmit any amount of power and vary the speed at a ratio of approximately 4 to 1, with little more waste than would be found in two ordinary shafts running together in parallel. (2) These expan-

sion pulleys make possible an efficient short drive, their construction being such that the sag and elasticity of the belt are not required to be considered. (3) No expensive special belts are necessary and all pulleys used on the gear are between the bearings, which not only economizes in space, but insures working strains being normal, prolonging the life of the gear. (4) All gears are adaptable for mounting on girders, ceiling, wall or floor, and the bearings, which are of best phosphor-bronze, are (with the exception of the gear occupying floor positions) lubricated from a magazine oil box, which only requires the attention of the oiler about once a month. Those intended for floor positions and the heavier-sized machines, Nos. 8 to 14, are ring oiling. (5) That every part of the device is designed to be sufficiently substantial to withstand abnormal strains. The gear is perfectly adjustable and is built like a machine tool under practical and careful supervision and of the best possible class of material obtainable.

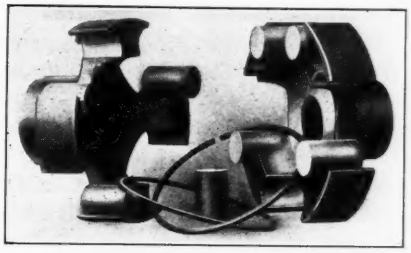
A New Flexible Insulated Coupling.

The illustrations show an improved flexible insulated coupling manufactured by the R. D. Nuttall Company, Pittsburg, Pa. The coupling consists of two interlocking spiders of cast-iron construction which are insulated by means of solid rubber cylinders. Outside of these the only other parts are two steel rings used to hold the rubber cylinders in position. The rubber members provide ample insulation and at the same time give the desired flexibility. It is furnished in sizes from five horse-power up.



FLEXIBLE CLUTCH COUPLING, ASSEMBLED.

This flexible coupling is especially desirable where electric motors are direct-connected to machinery which is subject to vibration, as, for example, a tube mill or a coal pulverizer in a cement plant, where the coupling relieves the motor from the shocks and jars of the machine. In addition, the end thrust of the crusher is overcome and the motor bearings run without heating.



FLEXIBLE CLUTCH COUPLING, DISASSEMBLED.

The "Hele-Shaw" Clutch.

The accompanying illustrations show some of the features of the "Hele-Shaw" clutch, which is being quite extensively and successfully employed in a wide range of mechanical drives. This is an English device, for the manufacture of which, under the American patents, the Merchant & Evans Company, 517 Arch street, Philadelphia, Pa., has secured the exclusive license. Something like 25,000 horse-power has been installed by the English manufacturers during the past four years in England and Europe, in over fifty different applications, ranging from one to 1,000 horse-power.

Fig. 1 illustrates a forty-five horse-power car clutch such as is used in automobiles making a speed up to 1,000 revolutions per minute. Fig. 2 illustrates the same clutch as in a fan flywheel. This is a sectional view of the interior mechanism of the clutch.

The clutch consists essentially of a pack of metal plates encased in an oil-tight drum. The peculiarity of the clutch and its merit lie in the fact that the engagement of the plates is in a thirty-five-degree

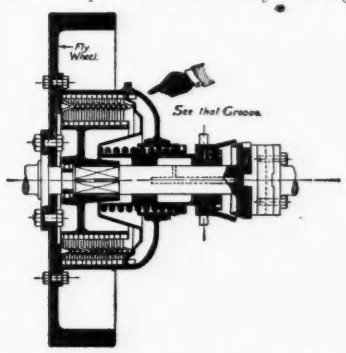


FIG. 2.—SECTIONAL VIEW, "HELE-SHAW" CLUTCH.

V-shaped circumferential groove. By virtue of engaging a V-shaped groove of one-third of a plane surface, each pair of plates does three times the work of a flat pair, or the same work with one-third of the spring pressure. By virtue of the engagement in the V-shaped groove, also, the flat portions of the plates, or the fins, as they are called, are always separated by about one-eighth of an inch. This permits the circulation of an oil bath constantly up to the point of work and radiates heat continuously, thus preventing the clutch from overheating due to slippage. In the event of the accidental absence of oil, the same amount of heat that would distort a flat plate does no injury to the "Hele-Shaw" plate, because of its transverse rigidity due to its peculiar groove. This makes it peculiarly advantageous for constant-duty work, such as planer and machine tool reverse gears, automobile and motor-boat work. Where the clutch is constantly working in and out of engagement, in pulley and coupling

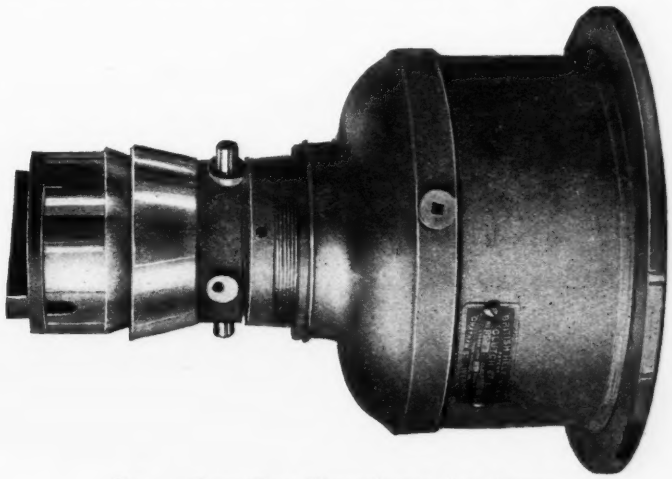


FIG. 1.—FORTY-FIVE HORSE-POWER CAR CLUTCH.

work, as with cranes, gas engines, and electric motor drives, the application is also very successful.

This clutch has a uniform rate of pick-up. When thrown into engagement it picks up its load on a straight line instead

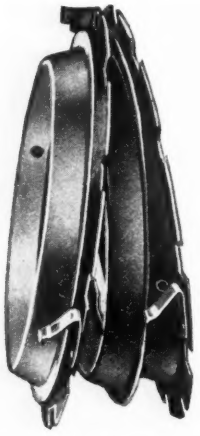


FIG. 3.—A PACK OF THREE OF THE DISCS.

of a curved line. This characteristic is particularly adaptable when used for connecting electric motors to printing presses and similar mechanical devices.

Fig. 3 shows a pack of three of the discs—two outer discs, and one inner. The inner discs are made of mild steel,

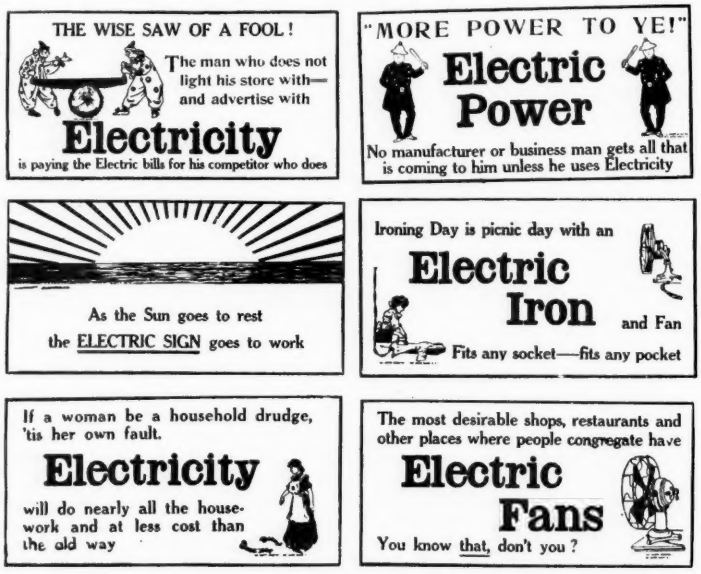
FIG. 4.—CLUTCH ADAPTED TO PINION.

and the outer of phosphor bronze, except for peculiar conditions, where all of the toothed plates are steel with intermediate slipper plates of bronze. The inner plates are toothed to the driven drum, and the outer plates are toothed to the driving drum. By proper mechanism the engagement is permanently or temporarily effected, as the design demands.

Fig. 4 shows the clutch adapted to a pinion drive.

An Attractive Series of Electrical Advertisements.

The accompanying illustrations are reproductions of an attractive series of electrical advertising cards which has been designed by Ben Alten Block, of New York city. The first, "The Wise Saw of a Fool," is printed in black with the clowns in colors and the word "electricity" in bright red. The second card is very striking, being printed in orange and black. The third card is printed in deep brown and a brick red. The fourth is


THE WISE SAW OF A FOOL!
The man who does not light his store with— and advertise with
Electricity
is paying the Electric bills for his competitor who does
"MORE POWER TO YE!"
Electric Power
No manufacturer or business man gets all that is coming to him unless he uses Electricity
As the Sun goes to rest
the ELECTRIC SIGN goes to work
Ironing Day is picnic day with an
Electric Iron
and Fan
Fits any socket—fits any pocket
If a woman be a household drudge, 'tis her own fault.
Electricity
will do nearly all the housework and at less cost than the old way
The most desirable shops, restaurants and other places where people congregate have
Electric Fans
You know that, don't you?

AN ATTRACTIVE SERIES OF ELECTRICAL ADVERTISEMENTS.

printed in a deep blue and a flat brick red. The fifth card is in bright green and red, and the sixth in black and red.

These cards measure eleven by twenty-one inches, and are printed on heavy bristol board.

New Haven to Sell Its Trolley Lines.

The Supreme Court of the state of Massachusetts handed down a decision on May 8 to the effect that the New York, New Haven & Hartford Railroad had trangressed the law in securing control of the Worcester & Webster Street Railway, the Webster & Dudley Street Railway, the Springfield Street Railway, the Berkshire Street Railway, the Worcester & Southbridge, and the Blackstone Valley Street Railway companies. The New Haven company owns these roads through the Consolidated Railway Company.

It has been announced that in view of the decision of the court that the New Haven company has not the right to hold stocks of trolley companies in Massachusetts, that it will be necessary for the company to dispose of this stock, unless the legislature decides that it is consistent with the interests of the commonwealth that it should be retained. The company believes that this principle also applies to the holding of Boston & Maine stock.

United States Civil Service Examination.

The United States Civil Service Commission announces an examination on June 17 to secure eligibles from which to make certification to fill a vacancy in the position of electrician elevator conductor, $900 per annum, in the Custodian Service at Tampa, Fla., and vacancies requiring similar qualifications as they may occur in the Custodian Service in that city. The age limit is eighteen to twenty-five years on date of examination. Applicants should apply at once to the United States Civil Service Commission, Washington, D. C., for application form 1052.

An examination will be held on June 3 to secure eligibles from which to make certification to fill a vacancy in the position of laboratory assistant, qualified as lamp inspector, at $900 per annum, in the Bureau of Standards, Department of Commerce and Labor, and vacancies requiring similar qualifications as they may occur in any branch of the service.

Applicants should apply at once for application form No. 1312.

Application to Vacate Interborough-Metropolitan Company's Charter Denied.

The Appellate Division of the Supreme Court on May 8 denied the application of Attorney-General Jackson for leave to bring an action against the Interborough-Metropolitan Company to vacate the company's charter and annul its corporate existence, on the ground that it was a monopoly. The decision was written by Justice Clarke, and Justices Ingraham, McLaughlin, Scott and Laughlin concur. The opinion points out that the precise thing of which the attorney-general complains has been expressly authorized by the law. The decision also says:

"The questions arising upon this appeal have been so recently and so thoroughly considered in the matter of the attorney-general for leave to commence an action against the Consolidated Gas Company that further consideration by this court seems unnecessary except to point out that the grounds for the present application seem more unsubstantial than in the gas company case, for in the gas case a commodity was manufactured and sold, while in the present case transportation only is furnished. Railroads, because they are common carriers and because, *ex necessitate rei,* they had conferred upon them the power to condemn property under the doctrine of eminent domain, have been peculiarly the subject of legislation. The policy of the state toward such corporations has been illustrated by a continued series of enactments regulating and controlling them to a minute degree. In the face of those enactments and that control, it seems to us a violent warping of the intention of the legislature to attempt to apply the provisions of Section 7 of the Stock Corporation law, that 'no domestic stock corporation, and no foreign corporation doing business in this state shall combine with any other corporation or person for the creation of a monopoly for the unlawful restraint of trade or for the prevention of competition in any necessity of life,' and Chapter 690 of the Laws of 1899, relating to the railroads of the state.

"Chapter 218 of the Laws of 1839, authorized one railroad corporation to lease the lines of another or to enter into traffic contracts. It applied to both street and steam roads.

"Chapter 305 of the Laws of 1885 granted the right to street railroads to lease or make traffic contracts subject to the burden of exchange of transfer facilities between the connecting lines."

The decision then reviews the railroad law passed by the legislature in 1890, which prohibited the leasing of parallel and competing roads other than street-car lines, and the amendment of 1892, which expressly exempted street-car lines from the foregoing provision.

"Under Section 78 of Chapter 565 of the laws of 1890, and Section 80 as amended supra," the decision goes on, "there was an absolute grant of power for the lease or merger or contract for the use of parallel or competing street railways and a similar grant for all other railroads, conditioned only on the consent of the railroad commission. That was the law at the time of the formation of the Interborough-Metropolitan Company."

The decision then recites Section 40 of the Stock Corporation law of 1890, amended by Chapter 601 of the laws of 1892, which provides that any stock corporation may purchase or dispose of the stock and bonds of any corporation if authorized to do so by a provision in the certificate of incorporation, and ends thus:

"It would seem from the foregoing citations of the laws and the cases that the precise thing of which the attorney-general complains has been expressly authorized by laws which have been interpreted and upheld by the courts of the state. The consideration of the legislation of these cases, in addition to the views expressed by us in the gas company case, lead to the conclusion that there is no warrant upon the facts set forth and under the law for the proposed action by the attorney-general, and that, therefore, in the exercise of that discretion which the law has imposed upon the Supreme Court it is our duty to affirm the order of the Special Term refusing the application for leave to institute the action, and it is so ordered, with $10 costs and disbursements."

International Telegraph Conference.

The conference on telegraphic and allied subjects, which is held from time to time under the terms of the International Telegraph Convention of St. Petersburg, commenced at Lisbon, Portugal, on Monday, May 4. The following condensed report of the proceedings is given by the *Electrician,* London. The conference is being held in the Palacio Palmella, and the delegates were welcomed by an address from the Minister of Public Works, Senhor Carnet de Magalhaes, after which the conference was presided over by the principal Portuguese delegate, Councilor Alfredo Pereira, Director-General of Posts and Telegraphs and vice-president of the Portuguese Chamber of Deputies. The vice-presidents selected were Councilor P. B. Cabral (Portugal), M. Peter de Szalay (Hungary) and Colonel E. Frey (director of the International Bureau, Berne). It is anticipated that the proceedings will last from five to six weeks. After the inaugural proceedings the delegates elected four committees to deal with (1) Rules and Regulations (chairman, H. Babington Smith, (2) Rates (chairman, M. Bordelongue, France), (3) Telephones (chairman, M. Pop, Holland), (4) Drafting (chairman, M. Banneux, Belgium). In addition to the above, a special committee has been appointed to consider a number of propositions relating to the revision of the St. Petersburg Convention of 1875, under which all matters relating to International Telegraphy are regulated. On Monday evening a banquet was given in honor of the delegates, the guests numbering nearly 150. On Wednesday the delegates were present at the interesting ceremony of oath-taking by the new King of Portugal.

Edison Portland Cement Company Visited by Brooklyn Engineers' Club.

The Brooklyn Engineers' Club, Brooklyn, N. Y., visited the works of the Edison Portland Cement Company, at New Village, N. J., on Saturday, May 16. A special train left New York at 10.30 and conveyed the members of the club and guests to the works, lunch being served during the trip. En route the train stopped at Orange and picked up Mr. Edison and his party. The comforts of those on the train were looked after by W. S. Mallory, first vice-president of the cement company, and a corps of able assistants. The visitors were first taken through the quarry where the large steam shovels were busy loading skips with the stone from which the cement is prepared. They were then taken to the works and divided into parties and shown the entire operation of cement making. The capacity of these works is about 8,000 barrels a day, although recently a run of 10,800 barrels was made in twenty and one-half hours. Enormous quantities of crushed stone are kept on hand, enabling the quality of the cement to be accurately controlled, and the grinding process, upon which so much depends, is unsurpassed. Two storehouses at present have a combined capacity of 250,000 barrels. A third storehouse is in course of erection with a capacity of 300,000 barrels. These works were described in detail in the ELECTRICAL REVIEW for December 26, 1903. The additions to the works since then have been the extension of the storehouses, kilnhouses, in which the longest kilns in the world are in operation, and a fine new power-house containing three 1,200-horsepower cross-compound condensing engines direct-connected to three 800-kilowatt generators.

The party left New Village for the return trip to New York a little before five o'clock.

Current Electrical News

DOMESTIC AND EXPORT.

A $1,500,000 TELEPHONE COMPANY—The Rochester, Syracuse & Utica Telephone Company, of Rochester, N. Y., a reorganization of the Independent Telephone Securities Company, operating in central New York, has filed a certificate of incorporation with the secretary of state. It is capitalized at $1,500,000. The directors named are: E. W. Peck, G. R. Fuller and W. Roy McCranne, of Rochester; E. B. Odell and C. H. Poole, of Utica, and H. S. Holden and A. H. Cowie, of Syracuse.

POWER COMPANY FILES MORTGAGE—The Telluride Power Company has filed a mortgage for $10,000,000, running to the Citizens' Savings and Trust Company, of Cleveland, Ohio, covering an issue of six per cent, thirty-year gold bonds, secured by rights, plants and franchises in Colorado, Utah and Idaho. Of the $10,000,000, $2,500,000 will be used to redeem outstanding bonds and take up floating indebtedness, and the remainder for further development of the company's business. The company has a large system of power plants and power transmission lines in the three states mentioned.

CHICAGO-MILWAUKEE ELECTRIC ROAD—The entire issue of $1,000,000 in receivers' certificates of the Chicago & Milwaukee Electric Railway Company has been sold to the Investment Registry, of London. George D. Moore, Detroit, will represent the new investors on the board of receivers, in place of Helge A. Haugan, resigned. The sale was made at ninety-five, a total of $950,000. Completion of the line into Milwaukee is set for July 15. The line will connect with the Northwestern elevated at Evanston, but eventually will run its own cars into Chicago from Milwaukee in two hours and forty-five minutes.

ENFIELD POWER COMPANY TO BUILD PLANT ON CONNECTICUT RIVER—The first steps have been taken toward organizing a company with a capital of $6,000,000 for the purpose of building a power plant on the Connecticut River at Warehouse Point and aiding the United States Government in opening the river to navigation between Springfield, Mass., and Hartford, Ct. The company will be known as the Enfield Power Company. In return for permission from the government to use the water power to generate electricity, the company will dredge a canal from Windsor Locks to Hartford which can be used for all boats passing up and down the river. The scheme is that of two brothers, Alexander Clogher, a New York engineer, and Ambrose Clogher, a Pittsfield lawyer. The capital will be supplied mainly by Springfield men. The company has been organized with the following officers: President, Charles H. Tenney; vice-president, Ralph P. Alden; clerk, Ambrose Clogher, of Pittsfield. Directors: Charles H. Tenney, Clifton A. Crocker and Charles T. Shean, of Springfield; Lyman A. Upson and Arthur R. Leete, of Thompsonville; Ambrose Clogher, of Pittsfield, and Alexander Clogher, of New York.

AGREEMENT BETWEEN BONDHOLDERS AND CREDITORS OF THE TOLEDO RAILWAYS AND LIGHT COMPANY—The bondholders and creditors of the Toledo Railways and Light Company have decided to co-operate and carry the property through the necessary refinancing processes. This agreement will prevent default in payment of the bond interest in July. Over $10,000,000 of bonds maturing in 1909 will be taken care of by refinancing and the interests of bondholders, creditors and stockholders will be protected without resorting to a receivership. The agreement also means that the company will make an effort to get a renewal of its franchises. The negotiations have been under way for several weeks between the bondholders, the largest of whom are Norman B. Ream, the Hale estate and the Blair interests in New York, and Barton Smith, counsel for the company, Joseph R. Nutt, of Cleveland, and creditors. There is over $1,500,000 of floating indebtedness, most of which is carried by Cleveland banks and some by Toledo banks. This committee has provided for the bond interest to be met in July, and when the $10,000,000 of bonds mature in 1909 the committee will refinance the road, covering bonds by the issuance of a new general mortgage on the property.

NEW INCORPORATIONS.

PLYMOUTH, OHIO—Plymouth Telephone Company, Plymouth. $4,000. Incorporators: E. L. Wescott and others.

AUGUSTA, ME.—Jackman & West Forks Telephone Company. $10,000. President, H. P. McKenney, of Jackman.

BOISE, IDA.—The Kootenai Power Company, of Spokane, Wash. $50,000. Robert Elder, of Cœur d'Alene, Idaho agent.

BEAUMONT, CAL.—Beaumont Gas and Electric Company, Beaumont. $25,000. Directors: W. A. Sewell, Alexander Reid and S. P. McLean.

MILWAUKEE, WIS.—Deer Park Telephone Company, Deer Park. $750. Incorporators: J. D. Thompson, W. H. Chadwick and Frank Abusch.

CONCORD, N. H.—Derry Electric Company. $50,000. Incorporators: Charles Bartlett, F. J. Shepard, J. B. Bartlett, Frank A. Hardy and B. T. Bartlett.

SPRINGFIELD, ILL.—Winchester Electric Company, Winchester. To operate a heat, light and power plant. $10,000. Incorporators: William Milhous, C. H. Condit, Sol. Hainsfurther.

SPRINGFIELD, ILL.—Montrose Mutual Telephone Company, Montrose, Ill. To operate a telephone system. $9,000. Incorporators: G. B. Tope, Reuben A. Isley, Campbell J. Elliott.

DOVER, DEL.—Myersdale Construction and Equipment Company, of Pittsburg, Pa. $100,000. To construct, maintain and operate railways, etc. Incorporators: H. D. Brenn, W. A. Wood, of Pittsburg, Pa.; W. W. Stand, of Bellevue, Pa.

NEW MANUFACTURING COMPANIES.

MUNCIE, IND.—The Nutting-Rowe Electric Company, of Muncie, has filed articles of incorporation with a capital of $5,000. The directors are: J. R. Hummel, Karl E. Nutting and W. L. Rowe.

COLUMBUS, OHIO—The Twentieth Century Electric and Repair Company, of Akron, has been incorporated with a capital of $10,000 by F. W. Hansen, C. L. Bigler, J. M. Hassler, George J. Schaffer and Ned K. Walters.

TOLEDO, OHIO—The Toledo Telephone Appliance Company, with a capital stock of $10,000 has been formed by Charles Clay Kingsley and others. A terminal block, the invention of Mr. Kingsley, will be manufactured. The company expects to furnish employment to about seventy-five people.

TRENTON, N. J.—The Seaboard Engineering and Construction Company, of Asbury Park, has been incorporated to conduct an electrical and mechanical engineering business. The capital is $125,000, and the incorporators are: Waldo W. Kurtz, A. J. Flynn, Fred F. Haberstick, of Asbury Park.

TRENTON, N. J.—The George R. Trumbull Electric Manufacturing Company has filed articles of incorporation at the office of the county clerk. The company is to deal in electrical appliances. The authorized capital stock of the concern is $50,000, divided into 500 shares at $100 each. The incorporators are: George R. Trumbull, N. B. Trumbull and J. A. H. Delp.

PERSONAL MENTION.

MR. I. W. MEACHEM, president of the New Process Raw Hide Company, of Syracuse, N. Y., has been elected president of the Chamber of Commerce of Syracuse.

MR. HERMAN EICHE, manager of the Bell Telephone Company's exchange at Nebraska City, Neb., has tendered his resignation. He is succeeded by C. F. Lambert, wire chief of the company.

MR. B. E. SUNNY has succeeded Mr. Arthur D. Wheeler as president of the Chicago Telephone Company. Mr. Wheeler becomes chairman of the board of directors, succeeding Mr. John M. Clark, resigned.

MR. PERCY H. THOMAS, of Thomas & Neall, electrical engineers, announces the removal of their New York office from No. 52 William street to No. 2 Rector street. The Boston office remains at No. 12 Pearl street.

MR. ROBERT STEELE was elected comptroller of the General Electric Company at a meeting of the board on May 15, the retiring officers being re-elected. The office of comptroller was abolished some years ago, but now is to be revived.

MR. HERBERT C. PETTY has been elected a director of the Crocker-Wheeler Company, Ampere, N. J., the well-known manufacturer of electrical machinery. Mr. Petty accepted a position in the sales division of the company in January, 1903, and advanced rapidly to the position of contract manager. The present honor conferred upon him is a recognition of the confidence in which he is held by the stockholders of the company.

MR. NATHANIEL W. LILLIE, purchasing agent of the New England Telephone and Telegraph Company, is the subject of a very interesting sketch in the April issue of "New England Telephone Topics." Mr. Lillie started in the telephone business October 8, 1877. This entitles him to rank among the pioneers, although he is a comparatively young man. In July, 1877, the Telephone Dispatch Company had been organized by Edwin T. Holmes, manager of the well-known burglar-alarm system. The Telephone Dispatch Company became immediately successful in connection with the different offices of the express companies, and Mr. Lillie was soon made superintendent of the company. In March, 1883, Mr. Lillie went with the so-called Lowell Telephone Syndicate, remaining in Lowell until the New England Telephone and Telegraph Company was formed in October, 1883, acting as secretary to General Manager Downs. On June 1, 1886, he succeeded George T. Manson as purchasing agent in charge of the supply department. In 1886 the total expenditures in this department amounted to $26,477.15. In 1906 the expenditures aggregated $4,316,375.30. Mr. Lillie has directed the operations of the purchasing and supply department for nearly twenty-two years. Although the Western Electric Company took charge of the supply department on May 1, the scope of Mr. Lillie's work will not be diminished, but rather increased. As supervisor of supplies, all requisitions will go through his hands.

TELEPHONE AND TELEGRAPH.

JERSEY CITY, N. J.—The New York & New Jersey Telephone Company has filed with the county clerk a building contract for the erection of the "Union Telephone Building," a four-story brick, fifty by one hundred feet on Jefferson street, near Palisade avenue, town of Union. The price of the building is $53,596.

JOPLIN, MO.—Plans and specifications have been prepared for the new Bell Telephone Building to be erected at 316 and 318 Joplin street. The building as planned will be two stories, and will cost $30,000. It will be constructed of brick with terra cotta or stone trimmings. The first floor will be used as general offices of the company and the second for the exchange. The storage and repair rooms will be located in the basement.

WILLIAMSON, N. Y.—At the annual meeting of the Wayne-Monroe Telephone Company, the following directors were elected: George Waters, of Pultneyville; Dr. Robert S. Carr, of Williamson; Dr. J. S. Brandt, of Ontario; Dr. Robert Morris, of Macedon; Albert Yeomans, of Walworth; Ledyard S. Cuyler, of Lyons; George R. Miles, of Wolcott; John A. Driscoll, of Rochester, and Frank D. Gaylord, of Sodus. The directors elected the following officers: President, George Waters, of Pultneyville; vice-president, Ledyard S. Cuyler, of Lyons; secretary and treasurer, Frank D. Gaylord, of Sodus.

WINNIPEG, MANITOBA—The Manitoba telephone commissioners have laid out plans for large extensions of the system throughout the province, anticipating over 1,000 new subscribers in the city and double that number from the surrounding districts, including the new construction in the municipalities. About $70,000 will be invested in a switchboard building for the Fort Rouge exchange, which will be constructed this year. Extensions will be made to the cable systems in Brandon, Portage la Prairie, Neepawa, Killarney, Manitou, Virden, Pilot Mount, Hamiota, and a large number of other small exchanges, at an approximate cost of $15,000 to $20,000. Long-distance lines will receive considerable attention. Close upon $300,000 will be expended for construction work during the present season by the telephone department.

ELECTRICAL SECURITIES.

It seems strange that notwithstanding a very evident improvement in the stock market for the past four weeks there were not evident any real indications of renewed business activity upon which to base a reason for the better feeling marketwise, and those best informed seemed disinclined to prophecy any stability for the rise. And just when predictions of reaction become ripe, it appears as if conditions had changed over night, and from every quarter come reports of renewed confidence and hopefulness. Not only this, but the fact is that every phase of industry seems to have felt this quickening, and with characteristic enthusiasm the people generally are keen for new accomplishments. The strike of the Cleveland railway employés has directed attention again to this subject, and the manner in which the holding company, acting for the municipality, will handle the situation will be watched with interest.

Dividends have been declared upon the following electrical securities: Philadelphia Electric Company; regular semiannual dividend of 2½ per cent, payable June 15, to stock of record May 22. Kings County Electric Light and Power Company; regular quarterly dividend of 2 per cent, payable June 1. Kansas City Railway and Light Company; regular quarterly dividend of 1¼ per cent on the preferred stock, payable June 1. Books closed May 20, and reopen June 1.

ELECTRICAL SECURITIES FOR THE WEEK ENDED MAY 16.

New York:	*Closing.*
Allis-Chalmers common	9½
Allis-Chalmers preferred	23¾
Brooklyn Rapid Transit	52
Consolidated Gas	121½
General Electric	139¾
Interborough-Metropolitan common	11¾
Interborough-Metropolitan preferred	31⅜
Kings County Electric	118
Mackay Companies (Postal Telegraph and Cables) common	64½
Mackay Companies (Postal Telegraph and Cables) preferred	67¾
Manhattan Elevated	139½
Metropolitan Street Railway	28
New York & New Jersey Telephone	105
Western Union	56¾
Westinghouse Manufacturing Company	53

The Westinghouse Electric and Manufacturing meeting has been postponed until the twenty-eighth of the current month.

Boston:	*Closing.*
American Telephone and Telegraph	117¼
Edison Electric Illuminating	—
Massachusetts Electric	43
New England Telephone	—
Western Telephone and Telegraph preferred	65½

Philadelphia:	*Closing.*
Electric Company of America	10
Electric Storage Battery common	32
Electric Storage Battery preferred	32
Philadelphia Electric	8⅝
Philadelphia Rapid Transit	16⅞
United Gas Improvement	85

Chicago:	*Closing.*
Chicago Telephone	123
Commonwealth Edison	93½
Metropolitan Elevated preferred	50½
National Carbon common	62⅛
National Carbon preferred	107½

ELECTRIC LIGHTING.

McALESTER, OKLA.—The city council is considering a plan to establish a municipal lighting plant.

CINCINNATI, OHIO—At the annual meeting of the Cincinnati Gas and Electric Company the directors were re-elected.

BERGEN, N. Y.—The Genesee County Electric Light, Power and Gas Company, of Batavia, has signed a contract to supply the village of Bergen with electric lighting.

BRIDGETON, ME.—The Bridgeton Water and Electric Light Company has been awarded a one-year contract for lighting Bridgeton. The price specified is $10.75 for each thirty-two-candle-power lamp.

BUCYRUS, OHIO—A recent municipal election was held to vote on the proposition of issuing $90,000 worth of bonds to build a municipal light plant. The result was two to one in favor of the bond issue. The contract with the present company expires early next year.

ELLSWORTH, MINN.—The village council has granted to F. M. Sadler a twenty-five-year franchise for furnishing electric street lights for the village. The franchise carries with it the provision that the city can purchase the plant at the end of any period of five years.

EVERETT, WASH.—Morton Ramsdell, manager of the Seattle-Tacoma Power Company, states that it is the intention of the company to reinsulate its line from Everett to the power plant at Snoqualmie Falls during the coming summer, changing the voltage from 15,000 to 60,000. The expense of this change will exceed $20,000.

PRATT, KAN.—S. S. Smith, proprietor of the Pratt electric light and ice plant, has sold out to a syndicate of local capitalists who have let a contract for the construction of a $25,000 plant. The new company expects to have the building and equipment completed in three months. The rapid growth of the city has rendered the present plant absolutely inadequate to supply the public needs.

VALDEZ, ALASKA—A reduction of fifteen per cent in the price of electric light has been made at Valdez by the Alaska Water, Light and Telephone Company, as a result of the agitation started at the recent municipal election against existing rates. A new company is planning to install a rival lighting plant this summer. The owners of the Valdez plant will expend between $10,000 and $15,000 this summer constructing dams to create reservoirs.

SEATTLE, WASH.—C. E. Magnusson, professor of electrical engineering, University of Washington, Seattle, informs us that the university will this summer install a power plant to include the following apparatus: one 200-kilowatt and one 100-kilowatt, sixty-cycle, 2,300-volt generators; eight five-horse-power motors for running ventilating fans; four five-kilowatt generators for experimental purposes in the dynamo laboratory, and the necessary switchboard wiring and transformers.

SPOKANE, WASH.—George Nixon, of the firm of Nixon & Kimmel, of Spokane, has been awarded a franchise by the commissioners of Spokane County for the installation of a power plant to furnish heat, power and electric lights for the towns of Deer Park, Chattaroy and Milan. The transmission line will be twenty-five miles in length. Mr. Nixon says he will develop all the power needed by a water-power plant to be established on his property near Deer Park, one side of which is bounded by the Spokane River.

CINCINNATI, OHIO—The annual meeting of the Tuscarawas County Electric Light and Power Company, of New Philadelphia, resulted in the re-election of all the directors and officers. This company was financed to a great extent by Cincinnati capital. The construction work is completed, and the company furnishes light and power to New Philadelphia and Canal Dover. The following were elected: A. S. Rice, G. A. Weil, H. E. Weil, John E. Roth, of Cincinnati; William Adams, Cynthiana; Y. Alexander, Lexington; S. D. Gilbert, of New York. The officers are: William Adams, president, and John E. Roth, secretary and treasurer.

CARSON CITY, NEV.—One million dollars is the stated capital of the Northwest Light and Water Company, with headquarters at Carson City. The incorporators are Robert E. Strahorn, of Spokane, president of the North Coast Railway Company; A. G. Smith, R. J. Danson and E. D. Doyle. It is generally believed at Wallace and Spokane that the light and water plants at North Yakima, Wash.; Wallace, Ida., and Sumpter, Ore., will be consolidated. The owners of the Wallace plant are known to control the others mentioned, and it is believed that the filing of the articles of the Northwest Light and Water Company is simply an initial step toward the merging of these interests.

ALBANY, N. Y.—The Public Service Commission has authorized the Hornell Electric Company to execute and deliver to Shirley E. Brown, as trustee, a mortgage upon all its property and issue certificates of indebtedness at five per cent, maturing May 1, 1931, to the amount of $100,000. The certificates are subject to call for payment any interest day at 102. The commission has authorized the Suffolk Light, Heat and Power Company to issue its six per cent debenture bonds to the amount of $15,000 to be sold at not less than par. The commission has authorized the Goshen Light, Heat and Power Company to make a first and refunding mortgage to secure the payment of bonds to the amount of $15,000 and to issue bonds equal to the amount of the mortgage.

ALBANY, N. Y.—The Public Service Commission for the Second District has granted authority to the Newburgh Light, Heat and Power Company to issue $330,000 of ten-year bonds bearing eight per cent interest. The company had applied for permission to issue $250,000 preferred stock, bearing eight per cent interest, but the application was denied on the ground that the commission could not sanction such a high interest rate in perpetuity. In writing an opinion in the present case Commissioner Decker says the present application seems to meet the objection made to the former, inasmuch as the bonds are for the short term of ten years and are convertible after two years into common stock of the company at the option of the holder. The present application was for $350,000, but the amount was reduced to $330,000.

PORTLAND, ORE.—It is announced that the power plant to be constructed by a Portland (Ore.) syndicate on the Snake River (Ida.) will generate at least 60,000 horse-power. When work on the plant was begun it was believed that at the lowest stage of the river only 36,000 theoretical horse-power could be developed, but daily gauges of the lowest stages of the stream show that at least 90,000 horse-power can be generated at the lowest stage of the river. Present plans call for a transmission system extending 350 miles with numerous substations in various directions from the main plant. Power will be furnished to the Seven Devils district, and to mines in eastern Oregon. Twelve thousand poles for carrying the wires are now on the ground. The engineers are boring for a rock foundation for the dam on the Snake River where the power is to be generated.

SPOKANE, WASH.—The Washington Water Power Company is negotiating for the overflow privileges on 6,000 acres of lowlands in the Cœur d'Alene Indian reservation on the St. Joe and St. Maries rivers in northern Idaho. Surveyors have been working along these rivers since the first of the year and the preliminary survey is nearly completed. The overflow of these lands is occasioned by the dam at Post Falls, Ida., where one of the lighting plants is now in operation. The level of the Cœur d'Alene Lake has been raised three feet above normal stage by the dam, and the backwater thus occasioned has covered thousands of acres along the Cœur d'Alene, St. Joe and St. Maries rivers. Arrangements have been made with the settlers along the Cœur d'Alene River for the purchase of land thus affected. Options covering nearly all of this land have been secured by the company and many of them taken up. In numerous instances easement for overflow only is secured, while in others the company purchases the land direct.

LEGAL NOTE.

EDISON LAMP PATENT DECREE—Judge Buffington, in the United States Circuit Court, Western District of Pennsylvania, has handed down a decree dismissing the bill in the case of the Edison Electric Light Company against the Novelty Incandescent Lamp Company, of Emporium, Pa. The latter company is an independent manufacturer and was sued for infringement of the Edison lamp patents.

ELECTRIC RAILWAYS.

SPOKANE, WASH.—The Spokane & Inland is surveying for an electric line to reach the top of Steptoe Butte, a distance of about four miles from the town of Steptoe.

REDLANDS, CAL.—A. G. Hubbard, of Redlands, has been granted a franchise to build an electric road extending east from the Redlands Central Railway to California street.

DANVILLE, ILL.—The Terre Haute, Indianapolis & Eastern Traction Line will be extended west from Crawfordsville to Danville, according to the statement made by John J. Appell, vice-president of the road.

ALLENTOWN, PA.—Officers of the Lehigh Valley Transit Company announce their purpose of establishing a fast trolley express service between Philadelphia and Allentown and other points along the system.

OWOSSO, MICH.—Edward Mandeville, of Philadelphia, and Gilbert L. Taylor, of Owosso, have been appointed receivers for the Owosso & Corunna Electric Company. Default was made in the payment of bond interest.

CINCINNATI, OHIO—J. G. Schmidlapp, promoter of the "L" road for this city, is satisfied with the "enabling act" passed by the Ohio legislature, and will now seek a franchise. The road, it is calculated, will cost $400,000 per mile.

WEST POINT, OHIO—The power plant of the Youngstown & Ohio River Railroad Company has been placed in operation, and power is now being furnished to operate cars between this place, Lisbon, Salem, Columbiana and Youngstown.

EUREKA, MILLS, VA.—Wood Bouldin, Jr., and J. S. Easley, civil engineers, of South Boston, contemplate establishing an electric line from Drake's Branch, on the Southern Railway, *via* Charlotte Court House, to some point on the Virginian Railway.

WEST CHESTER, PA.—The West Chester & Wilmington Electric Railway Company has awarded the contract for building a line from here to Wilmington to the Eastern Construction Company. The length of the road is sixteen and one-half miles.

JANESVILLE, WIS.—Chief Engineer Joseph Ellis, of the proposed Janesville-Madison interurban road, has begun actual operations. The line will run from Janesville to Madison *via* Edgeton, Stoughton, Lake Kegonsa, Lake Waubesa and South Madison.

SAN ANGELO, TEX.—J. H. Ransome, who is to build a street-car line in San Angelo, has secured land for a park just north of the city and says he expects to begin grading and laying tracks in a few weeks. He will build first to the park place and make it a summer resort.

POTTSTOWN, PA.—At the annual meeting of the stockholders of the Pottstown & Northern Street Railway Company the following officers were elected: President, George Hoeger. Board of directors: J. Milton Miller, W. A. Rosen, George Hoeger, William McIlvain and Dr. Walter A. Rigg.

WESTON, ORE.—The city council has granted to E. S. Isaacs and others a franchise for a trolley line extending along Water street from the north to the south corporate limits of the city. This is the longest thoroughfare in town. The franchise becomes void if the car line is not completed within two years.

WINCHESTER, VA.—The Winchester & Washington Electric Railway Company, owner of the power plant at Millville, W. Va., on the Shenandoah River, has given out contracts for $50,000 worth of additional machines, to be installed at the plant in July. This will make the capacity of the plant 3,000 horse-power.

KANSAS CITY, MO.—Work has been begun on the grading for an electric road to be built between Nevada and Springfield, Mo. The right of way was obtained last year. The road will be ninety miles long and will connect several small towns between Nevada and Springfield. It is not known who is back of the project.

AUSTIN, TEX.—The Northern Texas Traction Company has secured the approval of an amendment to its charter increasing its capital stock from $2,500,000 to $3,000,000. It is understood that the company is to issue stock dividends and that the money thus retained is to be used in betterments and possible extensions.

TERRE HAUTE, IND.—On application of contractor Donn Roberts, Judge Cox has appointed Charles Harlan receiver of the Terre Haute & Merom Traction Company. The company planned to build a road southwest from Terre Haute. So far $50,000 would cover the cost of labor and materials. Two miles of rail has been laid.

VICKSBURG, MISS.—Colonel S. S. Bullis, of Olean, N. Y., has purchased the Vicksburg Street Railway and Light Company, under a court decree, for $50,000. Colonel Bullis represented himself and associates in the purchase from Receiver W. A. Pollock. The sale includes the street railway, lighting plant franchises and all physical property. It does not affect the present holders of $325,000 of bonds.

CLARKSBURG, W. VA.—The capital stock of the Fairmont & Clarksburg Traction Company will be increased from 20,000 to 50,000 shares of a value of $5,000,000. A resolution to this effect will be passed at a meeting of the stockholders to be held in June. The company, which operates over fifty miles of trolley lines in this section, is owned by eastern capitalists. The lines will be extended at once.

CHEYENNE, WYO.—S. G. Griffin and Daniel Hewitt, of Colorado Springs, the latter president of the Interstate Realty and Improvement Company, it is understood will apply for a street railway and electric lighting franchise. Their plans contemplate a five-mile electric railway through Cheyenne to Fort Russell. The initial cost of such a system will be $75,000, and it is planned to have it completed by August.

EVANSVILLE, IND.—It is announced that the Evansville & Eastern Traction Line, running from here to Rockport, Ind., will be extended from Rockport to Louisville in the near future, passing through Grand View, Tell City, Cannelton, White Sulphur Springs, Wyandotte Cave, Corydon and New Albany. Officials of the company have gone over the proposed route and it is said the work of surveying will start in a short time.

HURON, S. D.—The contract for completing the survey of the Huron Gas and Electric Railway line has been let to Cross & Mack, of Minneapolis, who will enter upon the work at once. The proposed line is to operate between Huron and Aberdeen, the preliminary survey having been extended from Huron to a point about half way between Lake Byron and Dolan. The railway contractors will commence their work and continue into Aberdeen.

OAKLAND, MD.—The Swallow Falls Electric Light and Power Company, a corporation formed under the laws of Maryland for the purpose of generating electric power at Swallow Falls, about eight miles north of Oakland, has under contemplation the building of an electric railway from Oakland to Swallow Falls for the purpose of bringing to market the valuable deposits of coal and fire clay and lumber located along the proposed right of way.

TRENTON, N. J.—Improvements to the Princeton line of the Johnson Trolley Company, to cost $160,000, are to be made this summer. The primary object of this expenditure is to cut down the running time between Trenton and Princeton from forty to thirty minutes. Additional high-power cars have been bought and the power-house at Yardley will be enlarged to accommodate new machinery. A substation will be erected at Lawrenceville.

SPRINGFIELD, ILL.—Incorporation papers of the Wood River, East Alton & Bunker Hill Traction Company have been filed for record at Edwardsville. The first board of directors is composed of J. T. W. Maxey and B. A. Campbell, of East St. Louis. The stated intention is the construction of an electric line from the site of the new Standard Oil works in Madison County to Gillespie, in Macoupin County, where it will connect with the McKinley interurban line.

WATERLOO, IOWA—In order to extend its lines in Waterloo and the surrounding territory, the Waterloo, Cedar Falls and Northern Railway Company has negotiated a loan of $2,000,000. A trust deed covering this sum has been filed. It conveys the street railway and interurban railway property of the company in trust for forty years to Louis Boisot and the First Trust and Savings Bank, of Chicago. The loan bears five per cent, payable semi-annually.

SHEBOYGAN, WIS.—A contract for a twenty-five-year lease and immediate completion of the trolley line between Plymouth and

Elkhart Lake has been signed, following a meeting of the directors of the Elkhart line at Fond du Lac. Under the contract the Elkhart-Plymouth line will be completed by the Milwaukee & Fox River Valley Railroad Company by July 1, and the Sheboygan Light, Power and Railway Company gets a twenty-five-year lease of the tracks for service to Elkhart Lake.

CINCINNATI, OHIO—Work on the link in the Schoepf Cincinnati-to-Toledo interurban road is being pushed, and announcement is made that the sixty miles between Bellefontaine and Lima will be ready for operation by the middle of June. This makes a complete traction connection from Cincinnati to Deshler, Ohio, a distance of 148 miles. The distance to Toledo *via* this route will be 182 miles, and of the remaining distance between Deshler and Toledo a large part of the road is already completed.

UNIONTOWN, PA.—The Brownsville, Masontown & Smithfield Electric Railway Company has opened offices in the First National Bank Building and President J. W. Sheldon, Secretary John Luckett and Treasurer C. S. Crawford will locate there. Nearly a hundred men are at work between Masontown and West Masontown and soon will be put to work on the line from Masontown *via* Ronco, Gates, Edenborn and Lambert to Bridgeport. The contract for the construction of the road has been let to the Pennsylvania Railway Construction Company, Limited, of Pittsburg.

BALTIMORE, MD.—The Maryland Electric Railways Company has sold $250,000 first mortgage five per cent bonds of the Baltimore & Annapolis Short Line Railroad to the Fidelity Trust Company. The bonds are part of the issue of $1,000,000 authorized by the Short Line stockholders just prior to the consolidation of the company with the Maryland Electric in 1906. The other $750,000 of the bonds was sold after the consolidation and the proceeds used in electrifying the road. Electrical operation was commenced on May 4, when the first car was run from Baltimore to Annapolis.

MILLVILLE, N. J.—The proposed trolley line between Millville and Cape May now seems to be assured. Property owners along the proposed route have all given the right of way and are favorable to the project. The line will run from Millville due south, passing through Port Elizabeth, Dorchester, Leesburg, Eldora, Dennisville, South Dennis, Goshen, Cape May Court House, Burleigh and Rio Grande. At Burleigh a spur will be laid to Grassy Sounds and thence over to Five-Mile Beach to accommodate Anglesea, Wildwood and Holly Beach. The route to Cape May is shorter than that of the railroad.

EAST LIVERPOOL, OHIO—The Parkersburg Bridge Company, capitalized at $400,000, is behind a plan to construct a network of interurban lines which will connect Pittsburg and Cincinnati, down the Ohio Valley. The company was formed by Jason H. Brooks, Joseph G. Lee, Samuel C. Williams, Charles and James Newell, of this city. Plans for the bridge between Parkersburg and Belpre, Ohio, have been completed by E. K. Morris, of Pittsburg, Pa. After the bridge is completed a road is to be built to connect Pomeroy, Gallipolis, Coolville and Columbus, *via* Logan and Lancaster. With the building of a few gaps there will be a continuous interurban route between Cincinnati and Pittsburg. An application has been made to the government for the right to build the bridge, and, this granted, construction will commence immediately.

DATES AHEAD.

Telephone Association of Texas and Louisiana. Annual meeting, Dallas, Tex., May 25-27.

Oklahoma Electric Light, Railway and Gas Association. Annual meeting, Guthrie, Okla., May 25-27.

Canadian Electrical Association. Annual meeting, Toronto, Ontario, June 17-19.

Society for the Promotion of Engineering Education. Annual meeting, Detroit, Mich., June 22-27.

American Society of Mechanical Engineers. Semi-annual meeting, Detroit, Mich., June 23-26.

American Society of Civil Engineers. Annual meeting, Denver, Col., June 23-26.

American Institute of Electrical Engineers. Annual convention, Atlantic City, N. J., June 29-July 2.

Street Railway Association of the State of New York. Annual meeting, Niagara Falls, N. Y., June 30-July 1.

National Electrical Contractors' Association. Next meeting, Chicago, Ill., July 15-17.

Michigan Electric Association. Annual meeting, Grand Rapids, Mich., August 18-21.

American Society of Municipal Improvements. Annual meeting, Atlantic City, N. J., October.

INDUSTRIAL ITEMS.

THE NATIONAL ELECTRIC SIGN COMPANY, 113 Nassau street, New York city, announces several new sign specialties equipped with its motorless flasher device.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, announces the removal of its New York office from 120 Liberty street to room 1563 Hudson Terminal, 50 Church street.

THE H. KRANTZ MANUFACTURING COMPANY, 160 Seventh street, Brooklyn, N. Y., has published bulletin No. 21, devoted to standard and water-tight boxes for all electrical installation purposes.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., in bulletin No. 1505 describes and illustrates the new features of its heavy-duty Corliss engines. Copies of this bulletin will be furnished upon request.

THE CLEVELAND GAS AND ELECTRIC FIXTURE COMPANY, Conneaut, Ohio, in bulletin No. 1 describes "Conneaut" tungsten "Luminiers." Copies of this bulletin will be sent to those interested upon request.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing a forty-seven-page book devoted to various types of porcelain insulators, covering all voltages found in commercial practice. This catalogue will be mailed upon request.

THE WEBER GAS ENGINE COMPANY, Kansas City, Mo., has published bulletin No. 57 which gives an account of the gas-engine installation of the Cambridge Electric Light Company, Cambridge, Neb. Some remarkable figures are given. Copies of this bulletin and of the company's catalogue will be furnished upon request.

THE DAYTON MANUFACTURING COMPANY, Dayton, Ohio, has ready for distribution catalogue No. 145, devoted to the Silvey locomotive electric headlight. The company is selling agent for the United States Headlight Company, making oil, electric arc and incandescent headlights for locomotives and street and interurban railroads.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., in bulletin No. 54 describes and illustrates its new ground clamp. This ground clamp is made all in one piece, so that when the ground wire is soldered to it there is a perfect union between the ground clamp and the conduit or cable. There is also some very interesting descriptive matter concerning Paiste taplets.

THE NOVELTY INCANDESCENT LAMP COMPANY, Emporium, Pa., announces the erection of a western factory to handle the company's western business. It is understood that a new high-efficiency lamp will be manufactured in the new plant. The company now has factories at Emporium and at St. Mary's, Pa.

THE INTERNATIONAL ACHESON GRAPHITE COMPANY, Niagara Falls, N. Y., is distributing some very interesting literature devoted to "Oildag," which is a lubricant composed of deflocculated graphite and oil. The subject of deflocculated graphite has been given a great deal of attention recently, and it is stated that the merits of "Oildag" as a lubricant have been thoroughly proved by delicate tests.

DOSSERT & COMPANY, 242 West Forty-first street, New York city, have received orders from Walter Kidde for two-way connectors, cable taps and terminal lugs for use in the wiring of the plant of the American Hard Rubber Company, College Point, L. I. Mr. Kidde has announced, the company states, that he will hereafter use only Dossert connectors and terminals on all panel boards, generators and wiring of every description installed by him.

THE HOLOPHANE COMPANY, 227-229 Fulton street, New York city, has ready for distribution a series of new discount sheets, dated May 15, in which several important changes appear. It is to be especially noted that list prices on high-efficiency reflectors (for Meridian, Gem, tantalum and tungsten lamps) have been revised and are now the same as the prices and discounts quoted by the lamp companies. There will be no packing charge on high-efficiency reflectors.

J. G. WHITE & COMPANY, INCORPORATED, New York city, have been awarded the contract for engineering and constructing a

complete hydroelectric plant, with transmission lines, substations, etc., for the Central Georgia Power Company. This plant will be built on the Ocmulgee River, about thirty-six miles above Macon, Ga., supplying power to that point and to other points in the vicinity. The normal capacity of the plant will probably be 12,500 kilowatts. The crest of the dam will probably be 750 feet long.

THE MINNEAPOLIS STEEL AND MACHINERY COMPANY, Minneapolis, Minn., has published the "Engineer's Twin City Corliss Book." The various details of the "Twin City" Corliss engine are illustrated, and each element is marked with a numeral, so that it is an easy matter to order any piece by number. In addition to this listing there is a valuable chapter on valve setting. There are also several tables giving data for simple and compound, condensing and non-condensing engines, steam power-plant economy, feed-water heating, horse-powers of pulleys and belts, horse-power of shafting, and rope driving. Copies of this catalogue will be sent to those interested upon request.

THE JANDUS ELECTRIC COMPANY, Cleveland, Ohio, has issued a handsome bulletin devoted to the Daniels boulevard lighting system. This system has been patented by W. E. Daniels, operating engineer of the South Park Commission, Chicago, Ill., and its manufacture and exploitation have been undertaken by the Jandus Electric Company. The system consists of a re-enforced concrete base, shaft and ornamental capital, the whole surmounted by a complete arc-lamp mechanism enclosed within a twenty-inch opal glass ball globe. The system has been designed to operate on multiple direct current, multiple alternating current, and series alternating current. There are many other adaptations of the system which the bulletin illustrates. Copies of the bulletin will be furnished upon request.

Record of Electrical Patents.

Week of May 12.

887,071. TELEPHONE SYSTEM. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. A system employing a pair of sources of current at the central office.

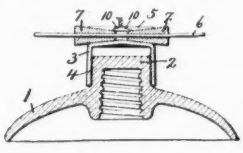
887,087. ELECTRIC THERMOSTAT. Harry G. Geissinger, New York, N. Y. The more expansible element is rigid, the other being flexible and normally straight.

887,088. SYSTEM OF TEMPERATURE CONTROL. Harry G. Geissinger, New York, N. Y. A system employing an electric heater controlled by a thermostat.

887,096. ELECTRIC INTERRUPTER AND INTERMITTER. John R. Kelley, Cincinnati, Ohio. An electrolytic interrupter.

887,106. ARMATURE-WINDING MACHINE. Charles H. Lewis, New Haven, Ct., assignor to the Acme Wire Company, Hamden, Ct. A device for gripping a plurality of armatures so as to rotate them about a common axis.

887,107. WIRE FASTENER FOR INSULATORS. Fred M. Locke, Victor, N. Y. A wire-holding element is fitted to the insulator, the former having an undercut groove and wedges for grasping the conductor.



887,107.—WIRE FASTENER FOR INSULATORS.

887,124. VOICE SCREEN FOR TRANSMITTER MOUTHPIECES. Robert H. Ralston, Denver, Col. An attachment shaped to fit the mouth of the speaker.

887,127. ELECTRIC ARC LAMP. Victor W. Riley and Herbert W. Rowing, London, England. The upper carbon is fed through a non-metallic tube, at the bottom of which is the gripping device.

887,157. ELECTRIC ALARM THERMOMETER. Wilhelm Walther, Homburg, Germany. A mercury thermometer with electrical contacts.

887,166. ELECTRIC PUSH BUTTON. Henry Wilhelm, New York, N. Y. The base is built up of discs of different sizes, having smooth edges.

887,220. APPARATUS FOR PRODUCING VOLTAIC HIGH-CURRENT ARCS. Harry Pauling, Gelsenkirchen, Germany, assignor to the firm of Salpetersäure-Industrie-Gesellschaft, G. M. B. H., Gelsenkirchen, Germany. The arc, struck between diverging electrodes, is deflected by a blast of gas.

887,221. LIGHTNING ARRESTER. John Pearson, Somerset, Wis., assignor of one-third to James F. Williamson and one-sixth to Frank D. Merchant, Minneapolis, Minn. A barrier is interposed between the arms of a horn arrester.

887,222. MEANS FOR AUTOMATICALLY CONTROLLING VOLTAGE AND POWER-FACTOR OF GENERATORS OPERATING IN MULTIPLE. John Pearson, Somerset, Wis., assignor of one-third to James F. Williamson and one-sixth to Frank D. Merchant, Minneapolis, Minn. A regulator is employed which may be controlled by the voltage at a point on the line.

887,223. WATER-WHEEL GOVERNOR. John Pearson, Somerset, Wis., assignor of one-third to James F. Williamson and one-sixth to Frank D. Merchant, Minneapolis, Minn. A centrifugal governor controls the turbine gates through a motor and relay.

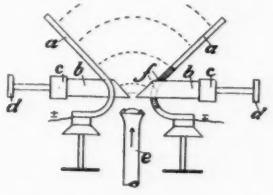
887,231. TELEPHONE TRANSMITTER. Elmer R. Corwin, Clyde, Ill., assignor to Corwin Telephone Manufacturing Company, Chicago, Ill. A removable bridge is attached to the back of the front plate.

887,233. CALL REGISTER FOR TELEPHONE SYSTEMS. William W. Dean, Elyria, Ohio, assignor to the Dean Electric Company, Elyria, Ohio. A registering device is attached to the front plate of the transmitter.

887,252. CONTROLLING SYSTEM. William B. Jackson, Madison, Wis., assignor to himself and Dugald C. Jackson, Madison, Wis. A rheostatic controller for a motor-driven compressor.

887,253. VALVE-OPERATING MECHANISM. William B. Jackson, Madison, Wis., assignor to himself and Dugald C. Jackson, Madison, Wis. An electrical system for controlling valves.

887,260. OPERATOR'S SELECTIVE RINGING KEY FOR TELEPHONE SYSTEMS. Ray H. Manson, Elyria, Ohio, assignor to the Dean Electric Company, Elyria, Ohio. A method of construction.



887,220.—APPARATUS FOR PRODUCING VOLTAIC HIGH-CURRENT ARCS.

887,261. ELECTRICAL SIGNALING AND SWITCHING APPARATUS. Ray H. Manson, Elyria, Ohio, assignor to the Dean Electric Company, Elyria, Ohio. A combined annunciator and spring jack.

887,263. CONNECTION SWITCH. George K. Thompson, Newton Highlands, Mass., and Frank R. McBerty, Evanston, Ill., assignors to Western Electric Company, Chicago, Ill. Protective devices are supported on the frame of the jack.

887,287. RAILWAY SWITCHING APPARATUS. John D. Taylor, Pittsburg, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. One terminal of the armature in an operating motor is connected to the middle point of the motor-field circuit.

887,288. APPARATUS GOVERNING THE PASSAGE OF CARS OR VEHICLES ALONG A RAILWAY AND THE CONTROL THEREOF. John D. Taylor, Edgewood Park, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. An alternating-current indicator controlling the movement of the vehicles.

887,289. APPARATUS FOR CONTROLLING THE PASSAGE OF TRAINS. John D. Taylor, Wilkinsburg, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. An indicator for a controlling lever of an interlocking machine.

887,290. CONTROL OF APPARATUS GOVERNING THE PASSAGE OF CARS OR VEHICLES ALONG A RAILWAY. John D. Taylor, Pittsburg, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. An electromagnetic controller for a motor-operated track switch.

887,291. SAFETY-CONTROLLER FOR ELECTRIC SWITCH-OPERATING APPARATUS. John D. Taylor, Pittsburg, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. A controller having two solenoids the circuit of each of which is closed through mechanical motion produced by the other solenoid.

887,313. TELEGRAPHIC APPARATUS. Frederick G. Creed, Glasgow, Scotland, assignor to himself, William Arthur Coulson, Nicol Paton Brown and Hugh Taylor Brown, Glasgow, Scotland. An automatic message-punching mechanism.

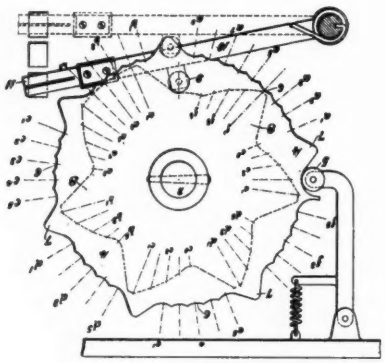
887,326. OXIDATION OF NITROGEN BY MEANS OF ELECTRICITY. Demetrio Helbig, Rome, Italy. The walls of the oxidizing chamber are formed of ionizing material.

887,331. ELECTRIC WATER HEATER. Oscar Johnson, Seattle, Wash. A heater formed of a series of concentric tubular electrodes.

887,333. ELECTRICAL HEATING ELEMENT. Frank Kuhn, Detroit, Mich., assignor to American Electrical Heater Company, Detroit, Mich. A detachable heating unit formed of a series of parallel resistance elements.

887,336. ELECTRIC INSULATOR. Herman Mieth, Vallejo, Cal. The insulator is protected by enclosing shells.

887,357. WIRELESS TELEPHONE. Nathan B. Stubblefield, Murray, Ky., assignor of twelve and one-half one-hundredths to Conn Linn, five one-hundredths to R. Downs, five one-hundredths to B. F. Schroader, five one-hundredths to George C. McLarin, five one-hundredths to John P. McElrath, two and one-half one-hundredths to Jeff D. Roulett, and one-twentieth to Samuel E. Bynum, Murray, Ky. Communication is established by means of a large fixed aerial coil and a small coil carried on the moving vehicle.



887,442.—CONTROLLER.

887,439. TROLLEY WHEEL FOR ELECTRIC CARS. George C. Stratton, Camden, N. J., assignor to Raymond L. Warren and Florence E. Cramer, Camden, N. J. A combined trolley wheel and protector.

887,442. CONTROLLER. Lewis L. Tatum, Norwood, Ohio, assignor to Allis-Chalmers Company, and the Bullock Electric Manufacturing Company. A drum controller for a multiple-voltage system with a cam-operated change-over switch.

887,455. ELECTRIC-LIGHT FIXTURE. Harry A. Bauer, Lansdowne, Pa. A cord fixture.

887,473. TELEPHONE RECEIVER. William Gibson, Danbury, Ct., assignor to the Gibson Manufacturing Co., Danbury, Ct. A receiver case formed of two parts of vitreous material.

887,476. APPARATUS FOR ELECTRIC OXIDIZING OF ATMOSPHERIC NITROGEN. Demetrio Helbig, Rome, Italy. The electrodes are enclosed in chambers formed within the walls of the oxidizing chamber, the surface of the walls being of ionizing material.

887,483. ELECTRICALLY PROPELLED VEHICLE. Joseph Ledwinka, Philadelphia, Pa. A motor frame is carried on non-rotatable trunnions upon which the vehicle wheels rotate, being driven by the armature shafts which extend through the trunnions.

887,501. ELECTRICAL CUTOUT. Philip T. McNally, Mandan, N. D. A switch controlled from a distance by means of a solenoid magnet.

887,504. AUTOMATIC SWITCH FOR TROLLEY LINES. Joseph Nelson, Cape May, N. J. An electromagnetic track switch.

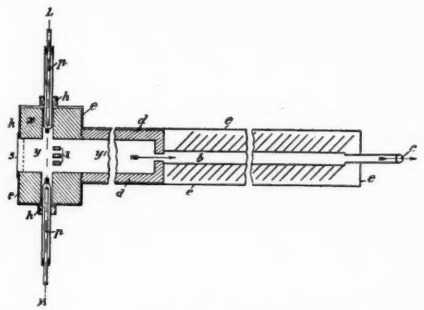
887,521. DYNAMOELECTRIC MACHINE. Henry G. Reist, Schenectady, N. Y., assignor to General Electric Company. Flexible pole-pieces are mounted on a rigid core.

887,525. LIGHTNING ARRESTER. David B. Rushmore, Schenectady, N. Y., assignor to General Electric Company. An arrester formed of a plurality of spark-gaps, groups of which are shunted by graduated resistances.

887,527. SERIES-MULTIPLE SWITCH. Howard R. Sargent, Schenectady, N. Y., assignor to General Electric Company. Four contact pieces are mounted on separate posts, three of the former being in one plane, and the fourth in another.

887,533. APPARATUS FOR TELEPHONING. Frederik Sindingchristensen, New York, N. Y., assignor to William H. Locke, Jr., Brooklyn, N. Y. The line conductor consists of two wires connected together through a plurality of condensers.

887,598. ELECTRICAL CONDENSER SUITABLE FOR USE IN WIRELESS TELEGRAPHY AND OTHER PURPOSES. Lucien H. Delloye, Paris, France, assignor to Société Anonyme des Manufactures de Glaces et Produits Chimiques de Saint Gobain Chauny et Cirey, Paris, France. Thin conducting bodies are incorporated in pairs in a mass of glass.



887,476.—APPARATUS FOR ELECTRIC OXIDIZING OF ATMOSPHERIC NITROGEN.

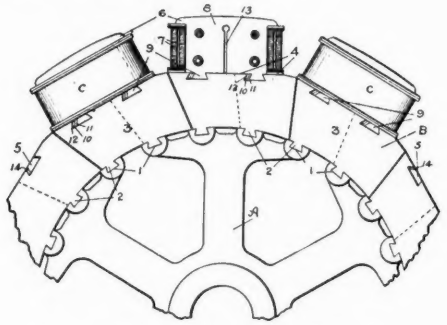
887,612. CONTROLLING MEANS FOR ALTERNATING-CURRENT MOTORS. Augustine R. Everest, Lynn, Mass., assignor to General Electric Company. The motor starts by splitting the phases and runs as a single-phase machine.

887,639. DYNAMOELECTRIC MACHINE. Louis R. Hornung, Norwood, Ohio, assignor to the Bullock Electric Manufacturing Company. Rigid insulating links couple the brush-holders together to prevent vibration.

887,642. VAPOR-ELECTRIC APPARATUS. Alexander M. Jackson, Schenectady, N. Y., assignor to General Electric Company. Means are provided for heating the electrodes for starting.

887,659. RECTIFIER SYSTEM. Osias O. Kruh, Schenectady, N. Y., assignor to General Electric Company. An inductance coil is placed in the circuit of the cathode, which is traversed by both the starting and the main current of the device.

887,660. STARTING DEVICE FOR MERCURY-VAPOR APPARATUS. Osias O. Kruh, Schenectady, N. Y., assignor to General Electric Company. A shield is provided to protect the starting conductor from the mercury electrode.



887,521.—DYNAMOELECTRIC MACHINE.

887,666. ELECTRIC WATER PURIFIER. James F. Lester, New York, N. Y., assignor, by mesne assignments, to Electrolytic Filtering and Purifying Company. An electric current is passed through the water between the nickel electrodes.

887,681. ELECTRIC SIGNALING. Francis W. Maxstadt and Francis W. Maxstadt, Jr., New York, N. Y. A single vibrator is provided for a plurality of bells which are tuned to work in unison with the bell hammers.

887,691. ELECTRICALLY DRIVEN VEHICLE. William B. Potter, Schenectady, N. Y., assignor to General Electric Company. A trackless trolley system.

887,723. ELECTRICAL SWITCH. John D. Hilliard, Jr., and Charles E. Parsons, Utica, N. Y. An oil switch of the plunger type.

887,737. MAGNETIC BLOWOUT FOR MAKE-AND-BREAK DEVICES. Stephen D. Field, Stockbridge, Mass., assignor to Pittsfield Spark Coil Company, Dalton, Mass. The contacts of a make-and-break device form the poles of a magnet.